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THE STUDENT'S HANDBOOK OF BRITISH MOSSES

BY

H. N. DIXON, M.A., F.L.S.

WITH ILLUSTRATIONS AND KEYS TO
THE GENERA AND SPECIES BY

H. G. JAMESON, M.A.

THIRD EDITION, Revised and Enlarged.

EASTBOURNE :
PRINTED AND PUBLISHED BY V. V. SUMFIELD, STATION STREET.

LONDON :
SOLD BY WHELDON & WESLEY, LTD., ARTHUR STREET, W.C.2.

1924.

THIRD EDITION, Revised and Enlarged

In one vol. 24/-
In two vols. (Text & Plates separately) 28/-
Pocket Edition, in two vols., thin paper 28/-

34379

PREFACE TO THE THIRD EDITION.

A new edition of this work being called for, advantage has been taken of the opportunity to include the species and varieties that have been added to our flora since 1904, and to bring the descriptions and notes up to date where correction or amplification seemed desirable; and I believe that in this way clearness and accuracy has been gained. Otherwise, so far as the text is concerned, as little alteration has been made as possible. A fuller treatment might perhaps have been desired in certain groups, *e.g.*, Sphagnum and Harpidium, in the light of recent investigation, but this would have meant an increase both in bulk and cost, and one of my principal aims has been to reduce these as much as possible. I have therefore limited myself, *e.g.*, in the matter of the introduction of new varieties, to the inclusion of only those of well marked status, while fully recognizing that reference might well have been made to many other varieties and forms.

The Plates have been entirely re-drawn by Mr. Jameson for this edition, with numerous emendations and additions, and are now reproduced by photography direct from the drawings themselves. Every figure in this book has been drawn from nature. Most of them are Mr. Jameson's own work, but the greater number of the figures taken from the supplementary Plates of the second edition have been copied by him from my original drawings.

It has been a question with me whether the nomenclature should be modified in order to conform more strictly to the Laws of Botanical Nomenclature as agreed at the International Botanical Congresses of Vienna and Brussels. These Laws, however, or rather the application of them to the Bryophyta, have not yet been finally settled; lists of *nomina conservanda*, for example, have yet to be drawn up; and any attempt to conform rigidly to these laws could not hope, as things are, to be final. To introduce any considerable number of unfamiliar names until these might reasonably be expected to represent the finally adopted nomenclature would be, it seems to me, to inflict gratuitous

trouble on the bryological student, and I have thought it best to make practically no alterations, hoping that when the proper time comes it may be done thoroughly, and once for all.

The late Dr. Stirton described a large number of new British species—considerably over 100—the value of which it was not possible to estimate from the descriptions alone. Since his death his herbarium has been available for study, and I have examined carefully the types of his new species. The results were published in the Journal of Botany, 1923, and I have not thought it necessary to repeat my conclusions in detail. As, however, the present work is in use abroad, I have given Stirton's names, for the convenience especially of foreign botanists, in the synonymy of the species to which they belong.

H. N. DIXON.

17 St. Matthew's Parade,
Northampton.
February, 1924.

PREFACE TO THE FIRST EDITION.

The object of the present work is to provide a practical handbook of the mosses of our Islands in such a form as to be as far as possible accessible to the considerable, and I hope increasing, number of students of these plants, many of whom find the larger and more expensive works on the subject beyond their means. Most bryologists have doubtless been asked to recommend the most suitable book for the student, and have probably experienced considerable difficulty in answering the question. Wilson's Bryologia Britannica—the prince of bryological books—is out of reach of many on account of its price, and is, after the lapse of forty years, far from covering the whole field of British mosses as they are known to us. Berkeley's Handbook is similarly out of date (about 465 species are there described out of some 600 as at present recognised); besides which some parts of that work, the plates especially, leave much to be desired.

Hobkirk's Synopsis, though containing much valuable information in a small compass for one already well versed in bryology, is somewhat too compressed to be of great service to the less practised collector, nor has it the advantage of illustrations. Braithwaite's splendid and elaborate work, still in the course of publication, which has done so much to stimulate the study of these plants in our country and which will doubtless remain our standard work for many years to come, is of necessity published at a price which puts it out of the reach of many. There is, therefore, unquestionably a demand for a modern book which may serve to take the place of the older works in the hands of the student, and which, while of modest pretensions in comparison with such a work as the British Moss Flora, may be sufficiently detailed to serve the purpose of the beginner as well as of the more advanced bryologist. How far the present work fulfils these requirements must be left to others to decide.

With the above object in view it has been necessary to compress the work into as small a space as is compatible with clearness, in order to keep the price as low as possible. I have therefore omitted many critical discussions which might properly have found a place had the space at my command been larger; and I have felt obliged to treat the varietal forms, especially of some of our more polymorphous species, in what may perhaps be deemed an eclectic rather than an exhaustive fashion. I have also endeavoured to describe the species in language as free from technicalities as possible, knowing that one great deterrent from a more general study of plants, especially of cryptogams, is the difficulty presented by the nomenclature and the descriptive terms. It is impossible, on the grounds of both brevity and accuracy, to avoid the use of technical terms, but I have endeavoured to use only such as seemed really necessary, and I believe that, with the aid of the Glossary, there is nothing in the work which will be found unintelligible by the ordinary student.

The Plates have been drawn by the Rev. H. G. Jameson, to whom also I am indebted for the Keys to the Genera and Species, and for advice and suggestion throughout the work, the MS. of which has all passed through his hands. The responsibility,

however, for the contents of the book must rest upon my shoulders, and any names or combination of names published here for the first time must be cited with my name alone.

Of the short-comings of the book no one can be more conscious than its authors. It would be inevitable, in dealing with a subject of this kind, even with the greatest facilities for attaining accuracy, that errors should creep in and facts be overlooked; and when the whole of the work has to be done in the scanty leisure snatched from exacting professional duties, the obstacles in the way of accuracy are greatly increased. I can only ask the student to bear this in mind in passing his judgment on the present work, and to be assured that any suggestions, corrections or additions will be exceedingly welcome.

H. N. DIXON.

East Park Parade,
Northampton.
May, 1896.

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INTRODUCTION.

1. GENERAL SKETCH OF THE STRUCTURE OF MOSSES.

In a work the primary aim of which is to enable the student to identify and thence to classify mosses there is neither the need of nor the room for a detailed account of their Morphology ; this will be readily obtained from works specially devoted to the subject. A short sketch of the structure of mosses is not, however, out of place, and will if carefully read serve to familiarise the student with the botanical terms necessarily employed in the body of the work. In the following sketch my aim is to describe the moss plant as it presents itself to a student examining it with a view to its identification, with as little reference to microscopical detail and to physiological and functional study as can be helped.

General Characteristics of Mosses.

The student is not likely to have any difficulty in recognising a moss, as such, from any other class of plants, with the exception of the very closely allied Hepaticae or Liverworts. Apart from the fructification, which in the latter plants is of a widely different structure (usually consisting of a dark globular capsule tipping a slender, delicate, white fruitstalk and ultimately splitting into four segments which spread horizontally into a cross), the Liverworts may as a rule be easily known by their vegetative structure, which is generally of a more flaccid, delicate texture, the leaves when present always very regularly imbricated, in the greater number of species in two flattened rows, one on each side of the stem, frequently bifid or multifid, which is never the case with mosses ; always nerveless, and always with a more or less rounded or hexagonal areolation—characters which are rarely if ever found combined in any of our mosses. There is a certain hardly describable appearance about the Liverworts which serves to identify them better than any description, and by which with a very slight experience the student will be able to recognise them, with perhaps one or two exceptions, at sight.

Mosses are found in various situations, and may be described as terrestrial, rupestral, arboreal, aquatic, paludal, etc., according to the matrix or the locality which they prefer. These terms, however, must not be taken too strictly, for while almost every species manifests a decided preference for one kind of matrix or environment, and whole classes of allied mosses are often linked together by a common preference of the kind, yet it rarely happens that a given species, whatever its natural habitat, may not occasionally be found in some other, more unusual situation.

As a general rule, however, the habitat of a moss may be looked upon as an important aid in determining its identity, and in all cases the nature of the soil or other matrix should be entered upon the label, with the locality.

The habit of the moss and its manner of growth, whether the separate plants are scattered singly, clustered or gregarious, or more or less densely tufted, are also points of importance and should be noted at the time of collecting.

The Vegetative Organs.

Mosses always consist of a stem and leaves, though either of these structures may be so reduced in size as to be inconspicuous. A certain ambiguity in the use of the terms "stem," "branch," should be here pointed out. They are frequently used, and are employed in this work, in a double sense, either as designating the actual solid cylinder upon which the leaves are arranged, or as embracing the whole visible structure, leaves included. Thus in speaking of the cuticular cells of the stem of Sphagnum, the first and more restricted meaning of the word is understood; whereas when a stem is spoken of as tumid or inflated, it is the whole structure, stem and leaves together, that is referred to. The absence of any convenient term to express the latter conception renders this extension of the words somewhat desirable, and it will, I believe, in no case give rise to confusion. I have occasionally used the term "frond" for the second use of the word.

The different modes of branching in different mosses are perhaps among the first things to strike the beginner, owing to the very different results they produce in the general appearance of the plants. There are two main types of branching by which all mosses may roughly be divided into two groups. In the one the stem is typically erect, simple, slightly forked, or with more numerous lateral branches, but producing the fertile flowers and later the fruit at the apices of the stem and of at least the principal branches; by this the apical growth of the stem is terminated, and further development can only take place by new branches, usually termed innovations, which are most frequently produced, singly, in pairs or in whorls, immediately below the flower. The tendency is therefore to grow upwards, and gradually to increase the number of branches from an originally simple stem, and this naturally conduces to the greater density of the tufts or cushions. Mosses of this type are termed Acrocarpous (Tab. LXII. 1, 2).

In the second type the stem whether little, or, as is usually the case, much branched produces its flowers on the side, not at its apex nor at that of the branches; consequently the apical growth of the stem is not terminated by the production of the fruit, but becomes indefinite, and the stems frequently attain a very considerable length. The natural consequence of this is that

the stems are rarely erect, but usually more or less prostrate or at least arched. This gives a wider, less dense and less elevated character to the tufts, which are often straggling. This is the type of the Pleurocarpous mosses (Tab. LXII. 3, 4).

The beginner will very speedily recognise these two types in the field; they are indeed so distinct that it was formerly the practice to make the distinction between Acrocarpous and Pleurocarpous mosses the primary division of the whole Class; this cannot now be maintained, but the distinction between the two types is of considerable practical assistance in the identification of mosses, if of less theoretical importance than has sometimes been held.

In the Pleurocarpous mosses the branching is frequently regularly pinnate; sometimes the branches in these cases are again branched, when the stem is bipinnate, and in a few cases the process is again repeated, resulting in a tripinnate arrangement; this is never the case with the Acrocarpous mosses, where the branching is either irregular, or more or less alternate, or imperfectly dichotomous, sometimes, but rarely, distinctly whorled. The innovations formed below the fertile flower frequently develope so rapidly as to equal or overtop the capsules, which then appear, but falsely, to be laterally produced (Tab. XXXIX. B; XL. A).

Mosses are not attached to their substratum by true roots, but there are usually present rootlets or radicles which perform the functions of roots, and are often produced throughout the whole length of the stem, or over the greater part, frequently in very great numbers so as to form a felt-like covering or tomentum (Tab. LXII. 2); they are usually of a reddish brown hue but may assume other colours. They may be produced, sporadically, upon the leaves or other parts of the plant, and they hardly differ morphologically from the chlorophyllose threads of the protonema; this is the network of branched, conferva-like filaments produced by the germination of the spores, from which is developed the moss plant; the protonema usually disappears at an early stage in the life of the moss, but in some of the smaller species it is persistent for a considerable period (Tab. XXXV. H).

In addition to the radicular fibres and the leaves, the stem is occasionally clothed with appendages of another kind, intermixed with the leaves; these are called paraphyllia, and are green, multiform, leaf-like or thread-like structures, sometimes formed like miniature leaves (Tab. LXII. 6), at others deeply cut, fringed, or so slender as to resemble branched threads (Tab. LXII. 5).

The leaves of mosses are of various forms, and the shape of the leaf affords, all things considered, one of the most important diagnostic characters of mosses; a reference to the glossary and to the figures will illustrate the various forms and explain the terms

used, which need not be recapitulated here; but it may be remarked that the leaves are always sessile, never stalked, and in outline range from subulate to orbicular, with almost every intermediate form; that they are never compound, scarcely ever lobed, though frequently serrate in various degrees, or sometimes laciniate. There is no epidermis or cuticular tissue, and the whole leaf is almost always formed of a single layer of cells (*v.* section, Tab. LXIII. 7, 11), rarely in part or altogether of a double layer (Tab. XX. H. 1x), with the exceptions of the nerve (or mid-rib) which when present is composed of narrow and elongated cells often of several layers in thickness and frequently showing some differentiation in structure, and of the marginal border which in certain groups of mosses is formed of different cells from those which compose the rest of the leaf, usually in such cases being more like those of the nerve (Tab. LXIII. 8).

The nerve is usually single, and may be very short, reaching only a part of the way up the leaf, or may extend to the apex, when it is called percurrent (Tab. LXII. 10), or beyond, when it is termed excurrent. Differing degrees of excurrence are characterised by distinct terms, mucronate (Tab. LXII. 14), cuspidate (Tab. LXII. 13), aristate, etc., the significance of which will be found by reference to the Glossary. The single nerve is very rarely forked above, or may produce, exceptionally, indistinct short lateral branches. In many groups of mosses however the nerve is double (Tab. LXII. 20), consisting of two independent branches free or united at the base; in this case it is almost always short, the branches very rarely indeed reaching above the middle of the leaf, and may be altogether wanting, in which case the leaf is nerveless. The expanded part of the leaf is frequently termed the lamina, in contradistinction to the nerve.

The nerve frequently bears spinose teeth at the back (Tab. IV. I. 1a), and in certain genera is furnished with variously specialised appendages on the upper surface (Tab. LXII. 18, 19); these are particularly developed in Polytrichaceæ and in the Sections Pterygoneuron and Aloina of Tortula.

The leaves may be more or less decurrent at the base, the lamina running down the stem for some distance on each side below the insertion or line of juncture of the leaf-base with the stem; this is sometimes so conspicuous that the stem is distinctly winged (Tab. LXII. 16); in certain groups it is a character of much importance, and in such cases the leaf should be separated with great care from the stem, in order that the decurrent part, or a portion at least, may be detached also. As a rule however the degree of decurrence can best be observed by stripping the greater number of leaves from a stem and examining the remaining ones under the microscope, while still attached.

It should be borne in mind that the lowest leaves on a stem, and sometimes too on a branch, are often very small or in other

ways far from typical, and these should never be selected for examination; the same objection frequently applies to the uppermost and youngest leaves, which may not be fully developed, though occasionally they are the only ones in which certain structures, of a very fragile nature, can be observed. In the Pleurocarpous mosses the leaves on the branches are usually smaller and less highly developed than the stem-leaves (Tab. LXII. 6), and unless otherwise mentioned the latter are always the ones described. A similar difference is sometimes, but more rarely, found between the leaves of the fertile stems and those of the barren branches in the Acrocarpous mosses.

The position of the leaves when moist, and also when dry, is of great importance, and in many species affords a clear and sufficient diagnostic character recognisable at once even in the field. When the leaves are not otherwise described they are to be taken as arranged equally all round the stem (Tab. LXII. 1, 2, 8); in some cases they are regularly distichous, *i.e.*, springing from opposite sides of the stem in two rows, in which case they are usually, though not always, complanate, *i.e.*, flattened out in one plane like the frond of a fern (Tab. LXII. 9, 10); this latter arrangement is even more frequently the case when the leaves are not truly distichous, but spring from all sides of the stem, the flattened or complanate arrangement giving them however a close resemblance to truly distichous leaves (Tab. LXII. 11). When a leaf instead of spreading out directly from its base is turned towards another side of the stem it is said to be secund; it usually happens that all the leaves in such cases are turned towards the same side, when they are termed homomallous (Tab. LXII. 12); when, as very frequently occurs, they are also curved, they are said to be falcato-secund (Tab. LXII. 3).

The leaves are frequently undulated (Tab. LXII. 11, 19) or plicate (Tab. LII. E, F); to observe this in the moist state it is best to separate the leaves and examine them under the microscope, taking care to submit them to as little pressure as possible; but when it is desired to observe this fact in the dry state it is almost invariably better to do so by means of the lens while still attached to the stem. The same remarks apply to the degree of concavity of the leaves, which is sometimes of importance.

The cell-structure, or areolation, of the leaves is a character of the highest value. It must be remembered that the cells at the base of the leaf and frequently those at the apex also are more or less modified, and the normal type of areolation of any species must be considered that of the median part of the leaf; and it is safest to take for examination a point about one-third of the length of the leaf from its apex; the figures of cells in the Plates, marked 1c., are all taken at this point. It is however often of importance to examine also the basal cells; in this and indeed in all cases it is of importance to select those of fully matured leaves.

In addition to the form of the cell, it is necessary in certain cases to note also the thickness or otherwise of the cell-wall. It is hardly possible to define a limit at which a cell-wall becomes incrassate, but a consultation of the figures referred to in the Glossary under that term will give a very fair idea of its signification. The cells figured in Tab. LXIII. 8, may be taken as typically thin-walled cells. In numerous mosses the cell-walls may be seen to be perforated by minute openings or pores, constituting passages between adjoining cells (Tab. XIV. C. 1c); this is especially the case when the walls are incrassate, and may frequently be observed in the basal cells of the older leaves when the younger and thinner-walled cells show no trace of it, as for instance in *Brachythecium rivulare*. The presence or absence of papillae on the surface of the cells is another point requiring observation. They are often visible on the margin of the leaf, but in other cases they are best seen, not by examining single leaves, but by placing a stem or branch under the microscope, so that the papillae may be observed as it were in profile (Tab. LXIII. 10). In a few cases, more especially where they are confined to the front or upper surface, it is necessary to cut a thin transverse section of the leaf (Tab. LXIII. 9, 11). This is also desirable in a few other cases, when it is required to observe the structure or form of the nerve or its appendages, as in Campylopus, Dicranum, and Polytrichum (Tab. VII. A; XI. K. L; XIV. C, F).

When it is desired to observe the basal cells, and especially those of the basal angles or auricles, it is especially necessary to remove the leaves carefully and gently, as otherwise these special cells are liable to be left adhering to the stem.

Reproductive bodies, termed gemmae, are not unfrequently produced on or among the leaves, or on special receptacles (Tab. LXIII. 33; XXXIII. D); these are of various forms and colours, but are usually green or brown, globular or club-shaped, articulate structures, resembling to the naked eye grains of dust or pollen; in certain cases their presence is of great assistance in the determination of species.

The Reproductive Organs.

The reproductive organs of mosses are usually situated among specialised leaves, forming the so-called flowers. They are of two kinds, the antheridia, or male organs, and the archegonia, or fertile organs. Besides the specialised leaves or bracts they are usually surrounded by numerous, hyaline, jointed hairs, called paraphyses. The leaves composing the fertile flower are called the perichaetial leaves or bracts; those surrounding the antheridia, when these are separate from the archegonia, are termed the perigonial leaves or bracts. These bracts, of either kind, are

often highly differentiated, and important to observe; but in many groups of mosses they are hardly distinct from the ordinary leaves.

The antheridia (Tab. LXIII. 37, 36) are small elliptic or clavate bodies, usually of a thin, loosely areolated texture and pale brownish colour, more or less wide and obtuse at the apex; they contain the antherozoids which, escaping, enter the archegonia and fertilise the oosphere, the cell which ultimately developes into the mature fruit.

The archegonia (Tab. LXIII. 34, 35) are narrower in shape, resembling a narrow, long-necked bottle, and are almost always of a deep red colour; they usually occur in some numbers in each perichætium, but it is as a rule only one which is fertilised and produces fruit.

The relative position of the antheridia and the archegonia is of great importance, and different terms are applied to the inflorescence in accordance with these different relationships; as they are somewhat difficult to grasp these terms are here tabulated.

The antheridia and archegonia may occur only on separate plants; the inflorescence is then termed *dioicous* (Tab. LXIII. 35, 36).

If they occur on the same plant it is termed *monoicous*. This includes several distinct forms, according to the positions of the two organs; they may occupy two different positions on separate parts of the stem, the antheridia then being usually enclosed in distinct perigonial bracts; the inflorescence is then said to be *autoicous* (Tab. XIII. E, F).

Or the antheridia and archegonia may be mixed together in the same flower, which is then termed *synoicous* (Tab. LXIII. 38).

Or, finally, the antheridia may be placed just below the fertile flower, without special perigonial bracts, simply in the axils of the lower perichaetial bracts; this form of inflorescence is termed *paroicous* (Tab. LXIII. 39).

Occasionally two of these forms of inflorescence are found side by side in the same species, when it is termed heteroicous.

It may be mentioned that the paroicous form of inflorescence appears to be confined to Acrocarpous mosses, and the synoicous very nearly so, occuring very rarely, perhaps exceptionally, in the Pleurocarpous species.

The fertile flowers are always more or less gemmiform, *i.e.*, bud-shaped; the male flowers are occasionally wider, with open and more or less spreading bracts; in this case they are termed discoid (Tab. XXXIX. E. 9 (m)).

Upon fertilisation the archegonium and its contents undergo great development; the oosphere becomes the capsule or sporangium, the outer part of the archegonium itself simultaneously developing up to a certain point, but ultimately rupturing midway so that the upper portion is carried up with the fruit, the lower

half remaining fixed at the base and forming a minute sheath round the base of the fruit-stalk, termed the vaginula ; this is occasionally covered with short, erect hairs (Tab. XXXIII. J. 5).

In very few cases the capsule remains sessile ; in the vast majority of species it is elevated on a seta, or fruitstalk, of varying length ; and it is by this process of elevation that the archegonium is ruptured. The upper half as has been mentioned is carried upwards with the fruit, and is known as the calyptra or veil ; it is usually of a thin membranous texture, more or less completely covering the capsule, and either falls off before the capsule is fully ripe or in other cases remains till maturity ; the increase in size of the capsule usually causes it to split from the base upwards ; when the fission takes place on one side only, or conspicuously on one side most strongly, the calyptra is said to be cucullate, *i.e.*, hood-shaped (Tab. LXIII. 13, 14) ; when it splits equally on two, three or more sides it is termed mitriform (Tab. LXIII. 12). The calyptra may be smooth or plicate, glabrous, papillose or hairy, the hairs either erect or pointing downwards.

The seta is variable in length and stoutness, occasionally rough with warts or papillae (Tab. LXII. 6 ; LXIII. 19). It is straight, flexuose, or arcuate, *i.e.*, curved like a bow ; the curving is sometimes even more pronounced, when it is said to be cygneous, *i.e.*, curved like a swan's neck. In the latter case it frequently becomes erect when old, and in some species it always takes an erect position when dry, while regaining its curved form when wetted.

When dry the seta is usually spirally twisted, and the twisting may be either to the right (*i.e.*, the spirals ascend towards the *right* to an observer supposed to be standing *within* the spiral ; from the outside they appear, on the side nearest him, to ascend to the *left*) or to the left. It is rarely, however, I believe, that the direction is so constantly different between any two allied species as to afford a good character of distinction, and it is only in a very few cases that I have relied upon it.

When the calyptra falls off or is removed the capsule is exposed ; it is usually more or less elliptical, but is frequently elongated and cylindric, equally often shortened and even globose, or it may be pyriform ; it is often striated (Tab. LXIII. 27), more rarely angular (Tab. VI. F) ; it is erect (Tab. XXXVI. J), inclined (Tab. LXIII. 40), cernuous (Tab. LXIII. 17), or even pendulous (Tab. LXIII. 18), and it is often more or less curved, or asymmetric. There are other forms which it less commonly assumes.

The capsule may be cleistocarpous (Tab. LXIII. 16), that is without any regular orifice or lid, bursting irregularly ; rarely it opens by valves (Tab. LXIII. 15). Usually, however, it opens with a lid, resembling the lid of an urn ; this falls off at maturity, its rupture being often assisted by the unrolling of the annulus,

a very highly elastic ring of cells surrounding the orifice at the point of juncture with the lid, and rolling back with considerable force and rapidity when the capsule is fully ripe. The annulus is however not always present.

The spores are usually produced in great numbers, and are green or brown; they are either smooth, or papillose or tuberculate; almost always more or less globose, rarely angular. They range, in point of size, with a few exceptions, between 10 μ and 25 μ in diameter. They usually surround a central column of tissue, called the columella, which is sometimes long enough to be distinctly visible above the mouth of the capsule after the fall of the lid, and occasionally is united to the interior of the lid, retarding its fall for a time and finally falling off with it.

The mouth of the orifice after the removal of the lid is in some mosses a bare rim, when the capsule is termed gymnostomous (Tab. LXIII. 22); but more frequently it is furnished with a fringe surrounding and in part closing the mouth; this fringe is termed the peristome, and affords, owing to the numerous forms and degrees of development it assumes, and its constancy throughout large groups of mosses, a very important basis of classification, especially as regards Orders and Genera. The researches of Philibert and others have recently brought into clearer light the great importance of this organ from a systematic point of view; and as the main divisions in the present work are based upon its structure, the student will do well to become familiarised with its general character and the terminology employed in its description.

The peristome may be single, *i.e.*, may form a single circle or fringe (Tab. LXIII. 23-26); or it may be double, consisting of two concentric circles, an outer and an inner (Tab. LXIII. 27, 29-32); very close however to one another, and sometimes even partly united. Taking the single peristome first, it sometimes consists of a thin membrane, rising conically over the mouth of the capsule, leaving only a minute aperture at its apex; much more frequently however, indeed in the vast majority of cases, the membrane is as it were split from top to bottom into a number of filaments, called the peristome *teeth*. These teeth are always produced in multiples of 4, indeed there are always either 4, 8, 16, 32, or 64, the median numbers being by far the most frequent. They vary very greatly in length, form, colour, and other characteristics, red being the predominant tint. They are usually very delicate in texture, in most cases consisting of a double layer of very thin plates, divided transversely into segments, with more or less distinct lines at the points of division, sometimes forming very strong trabecules, or bars, standing out prominently on the face of the tooth like the rungs of a ladder (Tab. LXIII. 25).

The double peristome is more complicated in structure. The outer fringe (Tab. LXIII. 29), superficially resembles the single

peristome already described, although differing in minute points of structure; the inner peristome (Tab. LXIII. 29-31), is always more delicate in texture, usually paler in colour; occasionally it consists of 8 or 16 delicate filaments or *processes* alternating with the outer *teeth*, more rarely opposite them; in other groups these *processes* are wider, meeting one another at their base; while still more often they are more or less united below, so as to form a continuous basal membrane surrounding the orifice, while their upper portions remain free; these upper portions being frequently more or less split or pierced along the median line. The spaces left between these free upper portions (*processes*) are often occupied by still more slender prolongations of the basal membrane, termed *cilia*, singly, or grouped in twos and threes (Tab. LXIII. 30); these are extremely delicate and thread-like, and frequently in the most highly developed forms bear short transverse appendages at intervals (Tab. LXIII. 29).

All these different parts exhibit much variation in the degree of their development, and the whole peristome is often reduced to a fringe of short rudimentary teeth around the orifice; the teeth are often also, on the one hand cleft, to a greater or less extent, into two or three branches (Tab. LXIII. 25), or again, more or less approximated or even united in pairs (Tab. LXIII. 28), or in fours, or they may be connected, in various degrees, by transverse bars, so as to form a kind of lattice work. The numerous and delicate forms, as well as the perfect regularity and the rich colouring of the peristome render this organ a most beautiful microscopic object. The teeth are strongly hygroscopic, usually, when mature, spreading more or less widely in the dry state, but rapidly converging so as to close the mouth of the capsule when moistened, or even when merely breathed upon.

The outer wall (*exothecium*) of the capsule frequently exhibits stomata, usually not very numerous, and as a rule arranged more or less distinctly in one or two rings round the capsule most commonly towards its base or upon its "neck," *i.e.*, the portion intermediate between the seta and the base of the spore-sac, or inner membrane containing the spores, which as a rule does not reach quite so low as the base of the outer case. The stomata are sometimes superficial, *i.e.*, on the surface of the wall of the capsule (Tab. XXXII. J. 12), sometimes immersed, *i.e.*, sunk in its substance (Tab. XXXIII. J, K. 12). This distinction is of great importance in the genus Orthotrichum, in which both forms of stomata occur, as it affords a safe and useful character for the separation of species and even of groups of species.

II. PRACTICAL EXAMINATION AND MEASUREMENT.

Mosses, even after having been long dry, generally at once resume their natural form and appearance, both to the eye and under the microscope, on being wetted. The harder parts,

however, and even the leaves of some of the Polytrichaceae and Bryaceae, may require to be heated for a short time in water over a spirit lamp.

To examine the leaves it is usually sufficient to strip off a few downwards (towards the base of the stem) with the forceps, choosing a place on the stem (or branch) where they are well developed, not the base or apex. When, however, the leaves are or may be auricled, or decurrent, it is best to dissect each one off singly under the dissecting microscope. Sections may be required where the leaf or its border is bistratose, or where the nerve is specially thickened or lamellated, and it is just in these cases that they are most easily made. To cut perfect sections with a razor requires both time and skill, but, with a little practice, sections quite good enough for examination may easily be sliced off downwards on the slide with a sharp knife under the dissecting microscope.

This latter piece of apparatus is an absolute necessity for the student, but it may be of the simplest description. A strip of wood 10 inches long, raised 2 or 3 inches by supports at the ends, with a hole at the centre and a lens of 1 inch focus supported above it, and a white card at an angle of 45 degrees below, gives a wide stage, with excellent support for the hands, and is a fairly efficient substitute for the more expensive article.

If the lid of the capsule is already gone, the peristome may often be observed in the dry state, but otherwise a thorough soaking is advisable before trying to remove the lid. Directions for examining the stomata on the capsule wall are given in the introduction to the genus Orthotrichum.

It is often necessary to determine the inflorescence. If old antheridia are found at the base of the seta the plant is at once recognized as synoicous, but they soon disappear, so their absence proves nothing. The flowers must therefore be looked for along the stem, or at the ends of the young shoots. Here again a single flower, according to whether it has both antheridia and archegonia, or only one of the two, will decide whether the plant is synoicous or not, which may be the point to be settled, but the decision as to whether it is monoicous or dioicous may be more difficult. If however, the flower dissected was taken from a *fruiting stem*, and proves to be male, the plant is of course autoicous.

Macroscopical measurements (of stem, leaves, setae, capsules, etc.) are usually given in inches and lines, (one line $= \frac{1}{12}$inch), occasionally in millimetres (mm.). Microscopical measurements (of cells, spores, etc.) are given in microns (one micron $= 1\mu = \frac{1}{1000}$ mm.). For purposes of comparison it may be borne in mind that for small measurements 100 $\mu = \frac{4}{1000}$ of an inch and for larger measurements 1 mm. = half a line, or 1 line = 2 mm. very nearly.

Measurements are made under the microscope either with an eye-piece micrometer (a great convenience), or by observing at the same time, with the camera lucida, the object and a scale of microns. Such a scale should be drawn on a card, once for all, with the camera lucida, and must always, of course, be used with the same objective and tube-length with which it was made. A very fair estimate, indeed, of the diameter of cells, etc., can be made by simply holding such a card at the level of the stage, and looking at it with the left eye, while the right eye looks down the microscope.

III. CLASSIFICATION, NOMENCLATURE, ETC.

The primary object of this work being to simplify the determination of our British Mosses for the student, and to make it available, as far as possible, for a beginner, it has been my chief aim throughout to introduce as little novelty and to employ as few technicalities as appeared compatible with accuracy and clearness. For this reason I have preferred to keep as closely as possible to the system of classification which prevails in the greater number of those works which the student is most likely, at the outset, to consult, and of which that employed in the second edition of Schimper's Synopsis Muscorum Europaeorum may be looked upon as the basis. The researches and critical writings of recent bryologists have added much to our knowledge, and have led to the proposition of new schemes of classification; but great as was the temptation to follow, more or less closely, on these new lines, it appeared to me that in a work specially intended to aid beginners the difficulties put in the way of the student, by a novel classification and order, were likely to outweigh the advantages they might confer.

On the other hand the researches of Philibert and others into the structure and development of the peristome have necessitated a certain amount of reconstruction. Schimper's system, and those of most other authors, have been to a very great extent founded on characters derived from this organ; and where groups have been united on the ground of supposed affinity between types of peristome subsequently shown to be remote from one another, and *vice-versa*, it is clear that it would be wrong to ignore the later conclusions, and I have felt obliged in some degree to modify the classification in accordance with this conviction. The chief deviations from the older order and grouping, and indeed almost the only ones of importance, will be found in the separation of the Grimmiaceae from the Orthotrichaceae, with or near which they were usually placed, and their removal to the Aplolepideae, where, undoubtedly, they belong; and the separation from the rest of the Bryales of the Nematodontoid group, including the three Orders Tetraphidaceae, Polytrichaceae

and Buxbaumiaceae. I have also discarded the usual division of the main group of mosses, the Bryales, into Acrocarpi and Pleurocarpi, believing that the characters involved in this division are far subordinate to those which separate them, according to the nature of the peristome, into the great groups of the Nematodonteae and the Arthrodonteae. If will be found however, that this view does not entail any alteration of the usual arrangement, the pleurocarpous mosses following the Bryaceae in the same order as is found in most works. One point that it is as well to bear constantly in mind is that differing *degrees* of development between peristomes are of slight systematic importance compared with dissimilar *types*. Thus the difference between the gymnostomous capsule of *Funaria fascicularis* and the highly complex peristome of *F. hygrometrica* represents but a slight divergence in relationship, whereas the peristomes of a Splachnum and of a Grimmia, though perhaps almost indistinguishable except under a close microscopical examination, are fundamentally different in their structure and indicate a wide divergence of type. In carrying out this principle it is clearly the soundest method of classification to group the cleistocarpous genera and species of mosses with those to which upon the ground of vegetative and other characters they appear most nearly allied, not to unite them together in a separate group ; and although this method entails a slightly greater difficulty in the identifying of the species in question, it undoubtedly presents to the student a more natural and therefore more scientific arrangement.

A conspectus of the system of classification adopted in this work will be found immediately following the Key to the Genera.

As to the choice of nomenclature I have been guided by very similar considerations to those which prompted the selection of the classification adopted. The *principle* of priority in nomenclature may be considered as universally accepted ; but the acceptance of the principle is far from having produced, at present, that uniformity which is one of the most important objects it sets out to attain ; nor can uniformity be hoped for until there is not only a general acceptance of the principle but an arrangement as to the rules by which the principle is to be carried out ; the limits, for example, of its retrospective action, and the much vexed question as to whether "priority" implies the retention for a species of the earliest valid trivial name or the earliest combination of generic and specific names. Following out the principle of priority for the specific name under whatever genus placed, Lindberg has arrived at a system of nomenclature very widely differing from that of most works on bryology, and he has been followed very closely by Braithwaite in the *British Moss Flora*. I have not felt it desirable to conform to this nomenclature, however ; partly on the grounds above given, that it would tend to confuse beginners who might be expected to have in their hands chiefly such works

as Schimper's *Synopsis*, Hobkirk's *Synopsis*, etc.; partly because of the extreme doubtfulness as to the finality of the nomenclature in question; and this even apart from the question of the general acceptance of those particular rules upon which the principle of priority has been carried out by Lindberg.

I have therefore maintained the nomenclature employed by Schimper (*Synopsis, Ed. II.*) as far as is compatible with the somewhat different classification here adopted, except in the following cases. When a generic name is pre-occupied for a phanerogamic or other class of plant (as in the case of Thamnium) I have, of course, dropped it and employed the earliest alternative name. And in a few cases where Lindberg's nomenclature has been used also in standard works of modern or comparatively modern date (as in the case of Catharinea *Ehrh.*, =Atrichum *P. Beauv.*) I have taken it as an indication of a general acceptance of the name and have employed it here. I hope that these few changes, while insufficient to cause any great difficulty to the student, may in a measure bridge over the difference between the "old" and the "new" nomenclatures, and prepare the way for the latter, without introducing any unaccustomed names but such as it may be anticipated will be finally adopted. With regard to specific names I have adhered with a very few exceptions, and then only in order to avoid confusion, to the rule in force with most European authorities on Flowering Plants, British and Continental, viz., of employing the earliest published combination of generic and trivial names under the adopted genus.*

The limits of the work precluded any full synonymy being given; nor, in a work of its scope, did it seem necessary to give, for instance, any such full and complete synonymy as that which forms so valuable a feature of the *British Moss Flora*. I have, with few exceptions, given merely the original authority for the specific name—when that differed from the authority for the binomial—and also the names employed in Schimper (*Synopsis, Ed. II.*) and in Braithwaite (*British Moss Flora*), when these differed from the name here employed.

I have not attempted to give any full list of localities, nor indeed to indicate the distribution of the species in our islands, except in the case of the rarest ones. An incomplete list of localities is, I hold, for this purpose not only useless but misleading, and I have not the materials for anything like a complete list even for the more uncommon mosses; nor would the size of the volume allow of it. I have therefore given no localities except for the very rare species, but when these are given they are intended to be, so far as I could make them, exhaustive.

The notes to the species are for the most part descriptive rather than critical, and will, I hope, be found of assistance; in

* See note on nomenclature in Preface to the 3rd Ed.

many cases two species may be distinguished, especially in the field, by some slight difference in habit or mode of growth, very difficult to define in set terms, but of more practical value, for this purpose, than many a clearly-defined but less easily observed structural character. The value of such notes will of course depend upon and be proportional to the degree of the writer's acquaintance with the plants themselves, especially in their growing condition, and in many cases this must of necessity be but small. While, however, making full use of other works on the subject, I have endeavoured, whenever possible, to describe each species from personal acquaintance with the plant itself, and, so far as might be, from a knowledge of it in the field. In the case of every species, and in the greater number of the varieties described, I have examined specimens, and in most cases British specimens of the plant.

I have introduced the plan, which is adopted in many continental books, but which has not, I believe, been hitherto employed in any of our British works on the subject, of giving in italics the salient and most distinctive generic and specific characters. This will, I believe, be found a help by the student, but it must be remembered that it is intended rather as a practical assistance in identification than as an indication of what are, from a systematic standpoint, characters of importance; for though as a rule the two run side by side it not unfrequently happens that a feature of such slight structural importance as colour or size may separate two species at a glance, but the italicising of these characters must not be looked upon as necessarily implying that they form the most important distinction between the two.

Another feature of the work which is undoubtedly in the bryological literature of our islands something of an innovation, is the introduction of sub-species. I have not employed this method of classification without considerable deliberation and some hesitancy; nor am I unaware that it has its disadvantages, and perhaps its dangers. The temptation to sub-divide genera into sub-genera, and species into sub-species, varieties, sub-varieties, forms and sub-forms, becomes increasingly great with the growth of more accurate knowledge and the closer study of forms. That these terms represent actual and existing degrees of affinity there can be no doubt, nor can there be any as to the importance of a recognition of the fact; but I hold that such minute sub-divisions are quite out of place in a general work of this kind, and are only justified in works dealing with special and limited groups, and even then only when they are dealt with from a somewhat different point of view, in short when the object of the work is of a theoretical rather than of a practical nature. I should therefore greatly deprecate the introduction of such a chain of terms, and their inevitably greatly multiplied nomenclature, into works intended primarily as hand-books for the student, and secondarily

only as text-books for the systematist I do not however think that the introduction of sub-species alone is open to the same objection, while it certainly meets some of the difficulties which constantly present themselves to the classifier who has no middle choice between species and varieties. While the method pursued here gives, I believe, a truer view of the relationships of the plants in question than if they were treated either as independent species or as merely varieties, I do not think it will be found to render the classification in any way more complex or more cumbersome. I have retained the ordinary binomial designation as in the case of full species, and the only practical difference will be found to be that the sub-species are not numbered in the headings, but indicated by an asterisk.

The Key to the Genera and the Keys to the species under each genus have been re-written to suit the arrangement of the work, by the Rev. H. G. Jameson, from his "Illustrated Guide to British Mosses." They will, I have no doubt, be found of material assistance to the beginner, especially in the larger genera ; but it must always be borne in mind that they are intended as a guide to, not as a substitute for, the fuller descriptions.

The Plates have all been drawn direct from nature by means of the *camera lucida*, and against each figure will be found the scale of magnification used, the sign × 1 being employed for unmagnified figures. The scale has been kept uniform throughout the entire series in the figures of the leaves (× 15), the leaf-apex (× 60), and the leaf-cells (× 180), so that the figures show not merely the form, but the comparative size of the structures. The advantages derived from this are too obvious to need pointing out. The numbered figures on the last two Plates are intended especially to illustrate the Introduction and Glossary, and to assist those who may not be familiar with the special terms used in describing mosses.

I have made an attempt to indicate in the Index—the pronunciation not only of the Generic names but also of the Specific names as well, by marking the accented syllable and at the same time indicating whether the vowel is long or short. I trust that this may be of some assistance to the student, but it must be borne in mind that the pronunciation as given here lays no claim to either authority or finality. The large majority of names present no difficulty, but in the case of words latinised from modern languages it must necessarily happen that the ordinary rules of Latin accentuation often fail to apply, and their pronunciation then becomes very much a matter of taste (*e.g.*, authorities differ as to whether Wilsōni or Wĭlsōni is the correct pronunciation). In such cases my preference is greatly in favour of retaining as nearly as possible the pronunciation of the name in the original language, and I have followed this principle here, while recognising that this view may not be shared by all bryologists alike.

GLOSSARY.

Acrocarpous, having the fruit terminal on stem or branch (Tab. LXII. 1, 2).
Acumen, a gradually tapering narrow point.
Acuminate, with an acumen (Tab. LXII. 20).
Acute, with a shorter, sharp point (Tab. LXII. 10, 16).
Aggregate, clustered.
Alar (or *Angular*) *cells*, the cells at the basal angles of a leaf (Tab. LXII. 20, 21).
Amphithecium, the outer layer of cells of the sporogonium.
Amplexicaul, clasping the stem.
Angular cells, cf. *alar cells*.
Annulus, a specialised ring of cells between the mouth of the capsule and the lid; usually separable, and often highly elastic.
Annular, like a ring.
Antheridium, the male reproductive organ (Tab. LXIII. 37).
Apiculus, a short, abrupt point.
Apiculate, ending in an apiculus (leaf, Tab. LIII. K).
Apophysis, a swelling of the fruit-stalk immediately under the capsule (Tab. LXIII. 28, 40).
Appendiculate (*cilia*), with short transverse bars at intervals (Tab. LXIII. 29).
Appressed, applied closely to the stem in an erect position.
Arboreal, growing on trees.
Archegonium, the reproductive organ of the fertile flower (Tab. LXIII. 34).
Arcuate, bent in a curve like a bow (capsule, Tab. IV. H. 5; seta, Tab. IX. D).
Areolation, the net-work of the cells of a leaf.
Arista, a fine bristle-shaped point.
Aristate, ending in an arista (perichætial bract, Tab. VII. D. 3). Cf. *mucronate*, *cuspidate*, *piliferous*.
Articulate, jointed (gemmae, Tab. XXXII. H. 10).
Ascending, pointing upwards or forwards (spines, Tab, IV. H. 1a). Inclined below and finally erect (stems).
Auricle, a small lobe or special patch of cells at the basal angle of a leaf (Tab. LXII. 20, 21).
Autoicous, having the male and fertile organs in separate inflorescences on the same plant (Tab. XIII. E, F).
Axil, the angle or hollow at the base of a leaf between it and the stem.
Axillary, belonging to, or in an axil (male inflor., Tab. LXII. 10).

Bicuspidate, with two short horns or points (Tab. VII. A. 1x).
Bifid, cleft into two divisions (peristome teeth, Tab. LXIII. 25).
Bi-stratose, in two strata or layers (cells, Tab. XX. H. 1x).
Bracts, special leaves surrounding the reproductive organs.
Bulbil, a minute bulb or bulb-shaped body (Tab. XLI. B. 10).
Bulbiform, like a bulb (plant, Tab. XXII. D).

Caespitose, tufted.
Calyptra, the thin veil or hood covering the lid of the capsule (Tab. LXIII. 12-14).
Campanulate, shaped like a bell (calyptra, Tab. LXIII. 12).
Canaliculate, channelled.
Capillary, *Capillaceous*, hair-like.
Carinate, keeled like a boat (leaf, Tab. XXII. D. 3).
Cartilaginous, firm and tough.
Castaneous, chestnut-coloured.
Catenulate, resembling a little chain.
Central-strand, a specialised group of cells in the centre of the stem.
Cernuous, slightly drooping (capsule, Tab. LXIII. 17, 19).

Chlorophyllose, containing grains of chlorophyll, or green colouring matter.
Cilia, hair-like threads (of inner peristome, Tab. LXIII. 29, 30). Cf. *processes*.
Ciliate, with cilia (perichaetial bract, Tab. VII. D. 3).
Circinate, curved into a circle (leaves, Tab. LIX. F).
Cirrate, curled.
Cladocarpous, having the fruit terminating a short, special, fertile branch (Tab. XLIX. B).
Clathrate, resembling lattice-work.
Clavate, club-shaped (gemma, Tab. LXIII. 33; antheridium, LXIII, 37).
Cleistocarpous, capsule opening irregularly, not by a lid or valves (Tab. LXIII. 16).
Cochleariform, concave like a spoon or ladle (leaf, Tab. LIII. J).
Collenchymatous, (of cells) having the walls thickened at the angles (Tab. LXIII. 3).
Columella, the central column of the capsule (Tab. LXIII. 28).
Coma, Comal tuft, a tuft of leaves at the tip of a stem or branch.
Complanate (of leaves or branches), flattened out more or less in one plane (Tab. LXII. 11).
Conduplicate, folded together, face to face (leaf, Tab. XLVIII. C. 1).
Constricted, suddenly narrowed (capsule at mouth, Tab. XXXII. C, E. 5; below mouth Tab. XXXII. F. 5).
Convolute, rolled together (leaf-margins, Tab. XXVIII. L, M. 1; perichaetial bracts, Tab. LXII. 12).
Cordate, heart-shaped (leaf, Tab. LX. J).
Crenulate, with fine, convex or rounded teeth (leaf-margin, Tab. XVI. C. 1c).
Cribrose, perforated, like a sieve (peristome teeth, Tab. XXI. F. 6).
Crisped, curled up and twisted (leaves, Tab. XVIII. B).
Cruciform, cross-shaped.
Cucullate, hood-shaped and (of the calyptra) split on one side only (leaf-apex, Tab. I. A. 2; calyptra. Tab. LXIII. 13, 14). Cf. *mitriform*.
Cultriform, curved like a short, wide scimitar (leaf, Tab. XLIX. G).
Cuneiform, wedge-shaped (peristome teeth, Tab. LXIII. 24).
Cuspidate, having a moderately long, stiff, acute point (Tab. LXII. 13). Cf. *mucronate, aristate, piliferous*.
Cuticle, the outermost skin of the stem.
Cuticular, belonging to the cuticle, (cells, Tab. I. F. stem x).
Cygneous, curved suddenly downwards like a swan's neck (seta, Tab. XXII. G).
Cymbiform, boat-shaped (leaf, Tab. I. A. 2).

Deciduous, falling off, not persistent.
Decurrent, with the base of the leaves running down the stem on each side, like wings (Tab. LXII. 16).
Decurved, curved downwards.
Decumbent, prostrate with the tip rising upwards.
Deflexed, bent downwards.
Dehisce, split open.
Deltoid, like a Greek Delta, or triangle (leaf, Tab. LIV. O).
Dendroid, tree-like.
Dentate, sharply toothed (leaves, Tab. LXI. C. 1, 1a).
Denticulate, very finely toothed, or obscurely toothed (Tab. XV. D, E, F, 1a).
Denuded, having the leaves worn off.
Diaphanous, colourless and transparent.
Dichotomous, repeatedly forked.
Dimorphous, of two forms.
Dioicous, having the male and fertile inflorescence on separate plants (Tab. LXIII. 35, 36).
Discoid, like a disc or plate (male inflorescence, Tab. XXXIX. E. 9m).
Distichous, in two opposite rows on the stem (leaves, Tab. LXII. 9, 10).
Divaricate, Divergent, spreading widely apart.
Dorsal, belonging to or on the back, *i.e.*, the face of a leaf remote from the stem.

Emarginate, having a small notch at the end (the nearest approach to this in the Plates is the leaf-apex, Tab. XXV. F).
Emergent, half uncovered; of the capsule, when the perichaetial bracts reach but do not overtop it (Tab. XXXIII. A). Cf. *immersed*, *exserted*.
Endemic, confined to a single country or geographical area.
Endothecium, the inner layers of cells of the sporogonium.
Epiphragm, a membrane covering the mouth of the capsule, (Tab. LXIII. 40).
Equidistant, at equal distances from one another.
Equitant, having the leaf-bases conduplicate and sheathing alternately one above the other on opposite sides of the stem (Tab. LXII. 10).
Erecto-patent, midway between erect and patent; *i.e.*, spreading from the stem at an angle of 45° or less (Tab. LXII. 1).
Erose, *Eroded*, irregularly notched or worn, as if gnawed (perichaetial bracts, Tab. XLVIII. D. 5).
Everted, abruptly turned outward.
Exannulate, without an annulus.
Excavate, (*leaf-insertion*) hollowed out in a curve.
Excurrent nerve, running out beyond the lamina of the leaf (Tab. LXII. 13, 14, 18).
Exothecium, the outer layer of the wall of the capsule.
Exserted, uncovered; of the capsule, when the perichaetial bracts do not reach so high as the base (Tab. XXXII. K.). Cf. *emergent*, *immersed*. Of the columella, when it protrudes from the mouth of the capsule (Tab. LXIII. 28).

Falcate, curved like a sickle (leaf, Tab. LXII. 20).
Falcato-secund, falcate and turned to one side of the stem (leaves, Tab. LXII. 3)
Fascicle, a bunch of leaves or branches.
Fasciculate, arranged more or less in bunches (branches, Tab. I. A. *).
Fastigiate, with the branches reaching to the same height.
Fibrillose, with fine fibres or threads (leaf-cell, Tab. I. A. 2cv).
Filiform, *Filamentous*, thread-like.
Fimbriate, fringed with cilia (Tab. III. A. B, C, 1).
Flagella, very fine string-like branchlets.
Flagelliform, like the thong of a whip.
Flexuose, bent backwards and forwards, or waved.
Foliose, *Foliaceous*, leaf-like, or leaf-bearing.
Frondose, *Frondiform*, like a frond, or a broad, flat, somewhat leaf-like expansion.
Fugacious, easily falling or broken off.
Fuscous, dull brown.
Fusiform, spindle-shaped, *i.e.*, narrowly oval with narrow, tapering ends.

Gemma, a small bud-like body, capable of reproducing the plant (Tab. IV. F. 10; XXIII. D. 10).
Gemmiferous, *Gemmiparous*, bearing gemmae (leaf, Tab. XIX. C. 10; XXIII. D. 1).
Gemmiform, bud-like.
Geniculate, suddenly bent (seta, Tab. XXI. I).
Gibbous, swollen on one side (capsule, Tab. XXXVII. A. 5; B. 5).
Glabrous, smooth, not hairy nor papillose.
Glaucous, bluish-grey.
Globose, round like a ball.
Granulose, rough as with grains of sand.
Gregarious plants, growing near together or clustered, but not in close tufts or mats.
Guard-cells, the two kidney-shaped cells enclosing a stoma (Tab. XXXII. J. 12).
Gymnostomous, bare, without a peristome (mouth of capsule, Tab. LXIII. 22).

Hamate, hooked (leaf, Tab. LIX. F).
Heteroicous, with more than one form of inflorescence in the same species.
Hispid, rough, with short, stiff hairs.
Homomallous leaves, all pointing in the same direction (Tab. LXII. 12).
Hyaline, colourless and transparent, like water (leaf point, Tab. LXII. 17).
Hygroscopic, readily absorbing water and thereby altered in form or direction.

Imbricated, closely overlapping, like the tiles of a roof (leaves, Tab. LXII. 7).
Immersed, covered up; of the capsule when overtopped by the perichaetial bracts (Tab. VII. G; XXXII. J). Cf. *emergent, exserted.*
Incrassate, of the cell-walls, thickened; of the cells, having thickened walls (Tab. IV. A, B, C. 1c; XXV. D. 1c, 1x).
Incumbent, folded inwards and lying upon.
Innovation, a branch or fresh shoot from a stem.
Insertion, the line of juncture of a leaf with the stem.
Involute, rolled inwards (leaf-margin, Tab. XI. K. 1; XXVIII. L, M. 1a).
Isodiametrical, having the vertical and horizontal diameters equal.

Julaceous, smoothly cylindrical, like a worm (Tab. LXII. 7).

Lacerate, Laciniate, jagged or torn (calyptra, Tab. XXXI. B. 7).
Lamellae, thin sheets or plates of tissue (Tab. IV. H. 1, 1x; VII. A. 1, 1x).
Lamina, the blade, or expanded part of the leaf, as distinct from the nerve.
Lanceolate, shaped like a lance-point (leaf, Tab. LIV. H).
Lenticular, like a double convex lens.
Ligulate, strap-shaped (proportionately longer and narrower than lingulate), (leaf, Tab. IX. 1).
Limb, the upper part of the leaf as distinct from the leaf-base.
Linear, very narrow, with nearly parallel margins (leaf, Tab. XV. E; cells, Tab. XI. A. 1c).
Lingulate, tongue-shaped (proportionately shorter and wider than ligulate) (leaf, Tab. IX. K).
Lumen, the cavity or space within a cell.

Mamillate, convex with a short point (lid of capsule, Tab. LXIII. 17, 18).
Micron, the thousandth of a millimetre, represented by the Greek letter μ.
Mitriform, of the calyptra, cleft on two or more sides, and symmetrical (Tab. LXIII. 12). Cf. *cucullate.*
Monoicous, having the male and fertile organs on the same plant.
Mucro, a very short, usually rather stout, abrupt point (Tab. LXII. 13).
Mucronate, having a mucro (Tab. LXII. 13). Cf. *aristate, cuspidate, pilifcrous.*
Multifid, cleft into many divisions.
Muricate, Muriculate, rough with minute, sharp points (spore, Tab. XXIV. F. 9).
Muticous, not pointed.

Neck, of the capsule, the lowest part, just above the point where it joins the seta.
Nodose, covered with knots or prominences.
Nodulose, with very small knots (cilia, Tab. LXIII. 30; cell-walls, Tab. LXIII. 6).

Obconical, inversely conical, *i.e.*, like a cone with the apex downward.
Obovate, inversely egg-shaped, *i.e.*, with the broadest part above (leaf, Tab. XXIV. I).
Ochraceous, yellowish brown.
Octofarious, arranged in eight ranks.
Oöphyte, the sexual generation of the moss, *i.e.*, the part of the plant produced from the spore, and bearing the sexual organs (cf. *Sporophyte*).
Oösphere, the central cell of the archegonium.
Orbicular, almost circular (leaf, XLIII. F. 1).
Ovate, Ovoid, egg-shaped, or nearly so (leaf, Tab. I. C. 2).

Pachydermous, thick-skinned.
Paired (*peristome teeth*), united or approximated two and two (Tab. XXI. H. 6; XXXII. E. 5).
Panduriform, fiddle-shaped (leaf, Tab. IV. B).
Papillae, minute rounded or acute protuberances (Tab. XXXVII. H. 1x; XXXIX. I. 1a).
Papillose, rough with papillae, (seta, Tab. LXIII. 19; cells, Tab. LXIII. 9, 10).
Paraphyllia, minute leaf-like or much branched organs among the leaves (Tab. LXII. 5, 6).
Paraphyses, jointed hyaline hairs growing among the reproductive organs (Tab. LXIII. 36, 38).
Parenchymatous, cells with broads ends abutting on one another, not dove-tailing into one another (Tab. LXIII. 7). Cf. *prosenchymatous*.
Paroicous, having the male and fertile organs in the same inflorescence, but not mixed, the antheridia being in the axils of the perichaetial bracts below the fertile flower (Tab. LXIII. 39).
Patent, spreading, *i.e.*, spreading from the stem at an angle of 45° or more.
Patulous, somewhat widely spreading.
Pedicel, a short stalk, or fruit stalk.
Pellucid, translucent, but not hyaline.
Penicillate, tufted, like a camel's hair brush.
Percurrent, reaching to the point but not beyond (nerve, Tab. LXII. 10).
Perichaetium, *Perichaetial bracts*, special leaves or bracts enclosing the fertile flower and often surrounding the base of the seta (Tab. LXII. 6, 15).
Perigonium, *Perigonial bracts*, special leaves enclosing the male flower (Tab, XXXIX. E. 9m, 4).
Peristome, the fringe surrounding the mouth of the capsule upon removing the lid (Tab. LXIII. 23–32, 40).
Peristomate, having a peristome.
Persistent, not falling off. Cf. *deciduous*.
Piliform, like a long, flexuose hair (nerve point, Tab. LXII. 18).
Pinnate, having numerous spreading branches on each side, like a feather (Tab. LVIII. D; LIX. K).
Piliferous, bearing a piliform hair (Tab. LXII. 18). Cf. *aristate*, *cuspidate*, *mucronate*.
Pleurocarpous, having the fruit lateral on a stem or branch, (Tab. LXII. 3, 4, 6).
Plicate, folded in pleats or furrows (leaf, Tab. LII. E. 1).
Plicae, folds, as above.
Plumose, regularly and closely pinnate like a plume or feather (Tab. LIX. K).
Polymorphous, of many forms.
Porose, having the cell-walls perforated by pores (Tab. XIV. F. 1c).
Processes, the main divisions of the inner peristome (Tab. LXIII. 29-31).
Proliferous, bearing abnormal or supernumerary outgrowths.
Prosenchymatous, cells with pointed ends dove-tailing into one another (Tab. LXIII. 8). Cf. *parenchymatous*.
Protonema, the green, branched threads produced from the spore, and sometimes persistent during the lifetime of the moss developed from it (Tab. XXXV. H.
Pseudopodium, a leafless branch resembling a fruit stalk, often bearing gemmae (Tab. LXIII. 33). Of Sphagnum, the stalk (false seta), bearing the capsule.
Punctate, *Punctiform*, rounded, dot-like (cells, Tab. LXIII. 2).
Punctulate, with minute dots or points.
Pyriform, pear-shaped (capsule, Tab. LXIII. 17).

Quadrate, square or nearly so (cells, Tab. LXIII. 1).
Quinquefarious, arranged in five ranks.

Radicles, rootlets springing from the stem, etc. (Tab. LXII. 2).
Radicular, belonging to the radicles.
Radiculose, covered with radicles (stem, Tab. LXII. 2).
Ramuli, minute branchlets.
Recurved, curved backwards.
Reniform, kidney shaped (guard cells of stomata, Tab. XXXII. J. 12).
Retort cells, special enlarged cuticular cells with a more or less recurved apex, in Sphagnum (Tab. III. G., branch).
Revolute, rolled back (leaf-margin, Tab. XXVII. K, L. 1a).
Rhomboid, "diamond-shaped" (cells, Tab. LXIII. 8).
Rhizome, a subterranean root-like stem.
Rostellate, with a short beak (lid, Tab. XI. B. 5).
Rostrate, with a long beak (lid, Tab. LXIII. 20, 21).
Rosulate, in the form of a rosette.
Rufescent, reddish brown.
Rufous, reddish.
Rugose, wrinkled (apophysis, Tab. LXIII. 28).
Rugulose, slightly wrinkled.
Rupestral, growing on rock.

Saccate, bag- or sack-shaped.
Scabrous, very rough, or warted.
Scariose, of a scaly consistency, dry and thin.
Secund, twisted to one side (leaves, Tab. LXII. 12).
Serrate, toothed (leaf-margin, Tab. XXXV. D. 1a).
Serrulate, finely serrate (leaf-margin, Tab. XVII. D. 1c).
Sessile, not stalked.
Seta, the fruit-stalk.
Setaceous, like a bristle (leaf-point, Tab. XIII. C).
Sheathing, more or less surrounding and clasping the stem or seta (leaf-base, Tab. V. G. 1; perichaetial bracts, Tab. LXII. 15).
Sigmoid, curved like the letter S (cells, Tab. XIII. B. 1c).
Sinuose, waved from side to side (cell-walls, Tab. LXIII. 5).
Sinuolate, faintly or minutely sinuose.
Spathulate, from a narrow base gradually growing broader to a wide, rounded top (leaf, Tab. XXV. F).
Spinose, with sharp spiny teeth (leaf-margin, Tab. LXII. 19).
Spinulose, with small spines.
Sporangium, *spore-sac*, the inner sac of the capsule, containing the spores.
Sporogonium, the spore-bearing part of the moss.
Sporophyte, the non-sexual generation of the moss, *i.e.*, all the organs produced by the fertilisation of the archegonium. Cf. *Oophyte*.
Squarrose, spreading out at right angles from the stem (leaves, Tab. LXII. 8).
Stellate, spreading out like a star.
Stoloniform stem, a slender creeping stem with minute leaves.
Stomata, pores in the wall of the capsule, surrounded by special guard-cells (Tab. XXXII. J, K. 12).
Striae, very faint furrows.
Striate, having striae.
Strict, straight and rigid.
Struma, a swelling on one side at the base of the capsule (Tab. LXIII. 21).
Strumose, having a struma.
Strumulose, having a small or indistinct struma.
Sub-, as a prefix, somewhat or almost; *e.g.*, sub-entire, almost entire.
Subula, a very fine point, like a needle or awl.
Subulate, having a subula (leaf, Tab. LXII. 21).
Subjacent, lying just below.
Sulcate, deeply furrowed (capsule, Tab. IX. I, M. 5).
Synoicous, having the male and fertile organs mixed together in the same inflorescence (Tab. LXIII. 38).

Terete, smooth and cylindrical.
Terrestrial, growing on earth.
Tetrahedral, having four triangular faces.
Tomentose, covered with a thick felt of radicles (stem, Tab. LXII. 2).
Trabeculate, with prominent transverse bars (peristome tooth, Tab. LXIII. 25).
Trapezioid, in the form of a trapezium, or triangle with the apex cut off.
Trifarious, *Tristichous*, arranged in three ranks (Tab. IX. A).
Trigonous, *Triquetrous*, having three angles.
Truncate, cut off abruptly (leaf, Tab. I. E. 1, 1a).
Tubular, like a little tube (leaf-apex, Tab. XII. B. 1).
Tumid, swollen.
Turbinate, top-shaped (capsule, Tab. XLIII. G. 5).
Turgid, swollen.

Unilateral, on one side only.
Unistratose cells, in one stratum or layer (Tab. LXIII. 7, 9, 11).
Urceolate, like an urn or pitcher (Tab. XXXI. E. 5).

Vaginula, the minute sheath surrounding the base of the seta.
Ventral, belonging to or on the front, *i.e.*, the face of a leaf next the stem.
Ventricose, swollen on one side.
Vermicular, narrow and curved, like a little worm (cells, Tab. LXIII. 4).
Vesicular, inflated like a bladder.
Verruculose, covered with wart-like prominences (cells, Tab. LXIII. 9).

Whorled, arranged in a whorl or ring (innovations, Tab. XXXIX. E).

ABBREVIATIONS EMPLOYED IN THE WORK.

Hab. *Habitat.*
Cf. *compare.*
ex p. } *in part.*
p.p. }
et nonull. auct. *and some authors.*
et mult. auct. *and many authors.*
et plur. auct. *and most authors.*
op. cit. *the above-mentioned work.*
sec. *according to* (*e.g.*, sec. Boulay, *according to Boulay*).
sensu, *in the sense of, as used by. . . .*
sqq. *and the following* (*e.g.*, *pages*).

Braithw. Br. M. Fl.	The British Moss Flora ; R. Braithwaite, M.D. 1888 sqq.
Braithw. Sphagnaceae.....	The Sphagnaceae or Peat-Mosses of Europe and North America ; R. Braithwaite, M.D. 1880.
Bry. Eur.) B. & S.)	Bryologia Europaea ; Bruch, Schimper and Guembel. 1836-55.
Bull. Torr. Bot. Cl.	Bulletin of the Torrey Botanical Club.
C.M. Syn.	Synopsis Muscorum Frondosorum ; C. Mueller. 1849.
Handb. Ed. I, (II)	The first (second) edition of this work, 1896, (1904).
Hobk. Syn.	A Synopsis of the British Mosses ; C. P. Hobkirk. 2nd ed., 1884.
H. & T.	Hooker and Taylor.
Journ. of Bot.	The Journal of Botany, British and Foreign.
Lindb. Musc. Scand.....	Musci Scandinavici ; S. O. Lindberg, 1879.
Lond. Cat. of Brit. Mosses	The London Catalogue of British Mosses. 2nd ed., 1881.
Manual of N.A. Mosses ...	Manual of the Mosses of North America ; Lesquereux and James, 1884.
Muscol. Gall.	Muscologia Gallica ; T. Husnot, 1884-94.
N. & H.	Nees and Hornschuch.
Rev. Bry.	Revue Bryologique, 1874-1922.
Schp. Syn.	Synopsis Muscorum Europaeorum ; W. P. Schimper. 2nd ed., 1876.
Wils. Bry. Brit.	Bryologia Britannica ; W. Wilson, 1855.
W. & M.	Weber and Mohr.

KEY TO THE GENERA.

The following Key is solely intended to enable beginners to refer an unrecognised specimen of moss to its proper Genus. To use it, the student must first consult the "General Key," following it down until he comes to the point where a capital letter refers him to the proper section for his specimen. Turning to this, he must again follow down the Key there until he arrives at the Genus required. For example, supposing his specimen is *Hedwigia ciliata*. In the "General Key" he looks at No. 1, which, as his leaves are *not* distichous, sends him on to No. 2, and here, as his leaves *have* hyaline points, he finds himself referred to "B." Turning then to B, he finds that No. 1, as his leaves are *without* lamellae, sends him to No. 3, under which the nerveless leaves of his plant point him to *Hedwigia*.

It should be borne in mind that the "General Key" *must* be consulted (at least until the student is thoroughly familiar with its method) before turning to the sectional headings, as these headings only imply that plants with such and such a description will be found under them, *if not already included in some earlier section, e.g.*, "D. Leaves bordered" does not include *Catharinea*, which had already appeared under "C. Leaves with longitudinal lamellae, etc."

GENERAL KEY.

1 { Leaves (at least in barren stems) distichous, or strongly complanate...**A**
  { Leaves inserted in three or more rows on the stem, not complanate 2

2 { Ls., at least the upper, with hyaline points, or with the nerve excurrent in a hair.....**B**
  { Ls. without hyaline or hair points (or the whole leaf colourless).....3

3 { Ls. with longitudinal lamellae on inner face of nerve.....**C**
  { Ls. without lamellae on inner face.....4

4 { Ls. bordered with narrow cells, or with a thickened border.....**D**
  { Ls. not bordered.....5

5 { Branch-leaves with spiral fibres in their cells.....1. *Sphagnum*
  { Cells without spiral fibres 6

6 { Plant brown or blackish, very fragile, on rocks; capsule opening by longitudinal slits.....2. *Andreaea*
  { Plant not normally blackish; capsule opening by a lid, or cleistocarpous 7

7 { Plant with fruit.....8
  { Plant without fruit.....18

8 { Capsule immersed (or emergent only)....9
  { Capsule exserted....10

9 { Cleistocarpous; plants minute, growing on the ground....E
  { Capsule with a lid; usually larger, on ground, rocks, trees, etc. ....F

10 { Peristome absent or rudimentary (or capsule cleistocarpous)....G
   { Peristome present....11

11 { Seta at end of stem, or of a leafy branch....13
   { Seta surrounded only by the perichaetial leaves at its base, at side of stem, or of a branch....12

12 { Leaves nerveless or shortly 2-nerved....19
   { Leaves single-nerved half-way or more....27

13 { Capsule with apophysis as wide as, or wider than itself....H
   { Capsule without apophysis as wide as itself....14

14 { Capsule striate, regularly furrowed when dry....I
   { Capsule smooth, or lightly and irregularly sulcate only when dry 15

15 { Capsule erect or sub-erect....15
   { Capsule inclined or cernuous, or on an arcuate seta....16

16 { Peristome teeth 4, or 16, entire, or slightly and irregularly cloven....J
   { Peristome teeth 16, deeply divided*, or 32 ....K

17 { Peristome single:....L
   { Peristome double ....M

18 { Leaves nerveless ** or shortly 2-nerved....19
   { Leaves single-nerved half-way or more....20

19 { Cells short, not much longer than wide, or long-oval in centre and short at sides of leaf....N
   { Cells elongate, at least twice as long as wide....O

20 { Plant bearing gemmae or granular filaments on the leaves, or on special stalked receptacles....P
   { Plant without such appendages....21

21 { Nerve very broad, about $\frac{1}{3}$ or more of base of leaf....Q
   { Nerve not $\frac{1}{3}$ of width of leaf....22

22 { Upper cells wide, 20 μ or more in shortest diameter....R
   { Upper cells small or narrow, rarely over 15 μ wide....23

23 { Leaves obtuse and entire (or bluntly apiculate)....S
   { Leaves acute, or obtuse and toothed....24

24 { Stem (acrocarpous) usually erect or ascending, simple or dichotomously branched, never pinnate; leaf-cells usually quadrate, rounded or hexagonal, rarely (as in Bryum, &c.) hexagonal-rhomboid; nerve often reaching apex or excurrent....25
   { Stem (pleurocarpous) usually prostrate or creeping, often long and with divergent lateral branches; leaf-cells most usually rhomboid or linear, or oval or rounded, not quadrate; nerve scarcely ever excurrent 27

25 { Leaves with enlarged, often brownish, angular cells....T
   { Leaves without dilated and coloured angular cells....26

26 { Ls. with excurrent nerve, or with long fine subula, into which the nerve runs....U
   { Ls. without excurrent nerve....V

27 { Cells short, not twice as long as wide....W
   { Cells at least twice as long as wide....X

* Segments sometimes united by cross-branches.

** In *Leucobryum* apparently so only.

A. LEAVES DISTICHOUS, OR STRONGLY COMPLANATE.

1 { Leaves distichous, in two rows only on the stem 2
  { Leaves complanate, but not truly distichous....5

2 { Leaves nerveless, cells lax....52. *Schistostega*
  { Leaves single-nerved, cells small....3

3 { Leaves very narrow, subulate-setaceous....12. *Swartzia*
  { Leaves wider, with a sheathing lamina at base....4

4 { Aquatic, very flaccid ; nerve ceasing below apex....29. *Octodiceras*
  { Terrestrial, or if aquatic more rigid ; nerve reaching to apex or almost so
  28. *Fissidens*

5 { Leaves single-nerved half-way or more....6
  { Leaves nerveless or 2-nerved....7

6 { Leaves bordered, nerve reaching apex or nearly....79. *Mnium*
  { Leaves not bordered, nerve ceasing far below apex....84. *Homalia*

7 { Leaves bordered, with 2 long nerves....86. *Hookeria*
  { Leaves not bordered, nerves very short or none....8

8 { Leaves very obtuse ; cells over 50 μ wide....87. *Pterygophyllum*
  { Leaves more or less pointed ; cells narrow....9

9 { Branches more or less pinnate ; cells rather short....83. *Neckera*
  { Branches not pinnate ; cells long and narrow....112. *Plagiothecium*

B. LEAVES WITH HYALINE POINTS, OR WITH THE NERVE EXCURRENT IN A HAIR.

1 { Leaves with longitudinal lamellae on inner face of nerve....2
  { Leaves without lamellae on inner face....3

2 { Leaves long, stiff, opaque, with numerous lamellae....6. *Polytrichum*
  { Leaves short, soft, with only 4 lamellae....10

3 { Leaves nerveless, or shortly two-nerved at base....36. *Hedwigia*
  { Leaves single-nerved half-way or more....4

4 { Nerve one-third or more of width of leaf near base....24. *Campylopus*
  { Nerve not one-third of base....5

5 { Lamina hyaline at apex, nerve (apparently) vanishing....6
  { Lamina not hyaline above, nerve excurrent in a hair....9

6 { Basal cells of leaf very long and narrow, nodulose....31. *Rhacomitrium*
  { Basal cells not nodulose, at most sinuose only....7

7 { Peristome double, capsule immersed, striate....51. *Orthotrichum*
  { Peristome single or none, capsule exserted, or immersed and smooth....8

8 { Calyptra plicate ; ls. with thickened plicae on each side of nerve
  32. *Coscinodon*
  { Calyptra smooth ; ls. without thickened plicae....30. *Grimmia*

9 { Cells rhomboid, with pointed ends....78. *Bryum*
  { Cells more or less quadrate....10

10 { Peristome absent or of short straight teeth....39. *Pottia*
   { Peristome long, twisted....40. *Tortula*

C. LEAVES WITH LONGITUDINAL LAMELLAE ON INNER FACE ; PERISTOME TEETH CONNECTED BY AN EPIPHRAGM.

1 { Leaves with a thickened, toothed border, lamellae few....4. *Catharinea*
  { Leaves not bordered....2

2 { Lamellae sinuose ....5. *Oligotrichum*
  { Lamellae straight, very numerous....6. *Polytrichum*

D. LEAVES BORDERED.

1 { Leaves 2-nerved ..... *86. Hookeria*
  { Leaves 1-nerved 2

2 { Cells (except the border), short, dense, sub-quadrate 3
  { Cells elongate, or large and roundish-hexagonal 4

3 { Border of elongate cells, more or less pellucid ..... *40. Tortula*
  { Border-cells scarcely elongate, opaque ..... *46. Cinclidotus*

4 { Cells lax, truncate-hexagonal; capsule erect; seta smooth ... *62. Funaria*
  { Cells hexagonal-rhomboid or roundish; capsule inclined or cernuous (except *Daltonia*) 5

5 { Border strongly toothed; ls. large ..... *79. Mnium*
  { Border entire, or more or less toothed near apex only 6

6 { Leaves large, roundish-ovate; cells not much elongate 7
  { Leaves more or less tapering above; cells elongate 8

7 { Leaves obtuse or bluntly apiculate; peristome teeth free ..... *79. Mnium*
  { Leaves shortly and suddenly acuminate; inner peristome a dome-shaped membrane ..... *80. Cinclidium*

8 { Nerve reaching apex or excurrent ..... *78. Bryum*
  { Nerve ceasing some distance below apex 9

9 { Leaves widely ovate or obovate; acrocarpous ..... *76. Webera*
  { Leaves narrow-lanceolate; pleurocarpous; seta rough ..... *85. Daltonia*

E. CAPSULE IMMERSED, CLEISTOCARPOUS.

1 { Plant growing from a persistent, green protonema 2
  { Protonema not persistent 3

2 { Calyptra minute; ls. nerveless, not or obscurely toothed *58. Nanomitrium*
  { Calyptra larger; ls. nerved, or nerveless and coarsely toothed *59. Ephemerum*

3 { Capsule with a minute persistent lid; leaves curled when dry ... *43. Weisia*
  { Capsule without a distinct lid; leaves scarcely curled 4

4 { Leaves lanceolate-subulate, cells long and narrow 5
  { Leaves ovate, ovate-lanceolate, or obovate 6

5 { Capsule globose, without any apiculus, spores few, large ..... *9. Archidium*
  { Capsule apiculate, spores numerous ..... *10. Pleuridium*

6 { Ls. serrate in upper half, nerve vanishing below apex ... *60. Physcomitrella*
  { Ls. entire, or toothed at apex only, nerve reaching apex or excurrent ... 7

7 { Two or three inner perichaetial ls. very wide and concave, usually toothed at apex; capsule globose, not (or very minutely) apiculate *37. Acaulon*
  { Inner perichaetial ls. less conspicuous, entire; capsule apiculate *38. Phascum*

F. CAPSULE IMMERSED, WITH A LID.

1 { Leaves nerveless 2
  { Leaves single-nerved 4

2 { Leaves complanate, more or less undulate ..... *83. Neckera*
  { Leaves not complanate nor undulate 3

3 { Aquatic plant; leaves thin, tristichous ..... *81. Fontinalis*
  { Terrestrial plant; leaves firm, not tristichous ..... *36. Hedwigia*

4 { Lid minute, not separating; plant very small.....*43. Weisia*
  { Lid larger, separating when ripe.....5

5 { Perichaetial leaves ciliate; capsule oblique.....*8. Diphyscium*
  { Perichaetial leaves not ciliate; capsule regular.....6

6 { Fruit on a short lateral branch.....*82. Cryphaea*
  { Fruit terminal.....7

7 { Peristome absent .....*22. Blindia*
  { Peristome present.....8

8 { Capsule not striate; peristome single.....*30. Grimmia*
  { Capsule striate, or smooth with double peristome.....*51. Orthotrichum*

G. PERISTOME ABSENT (OR CAPSULE CLEISTOCARPOUS).

1 { Seta curved.....2
  { Seta straight.....3

2 { Capsule with a lid.....*71. Philonotis*
  { Capsule cleistocarpous.....*38. Phascum*

3 { Capsule striate, furrowed when dry.....*49. Zygodon*
  { Capsule smooth, or irregularly sulcate only when dry.....4

4 { Leaves large, roundish, very obtuse; cells lax .....*53. Oedipodium*
  { Plant without large, round, obtuse leaves.....5

5 { Cells elongate, hexagonal, very lax and thin-walled.....6
  { Cells more or less quadrate, or elongate but small and narrow.....7

6 { Lid conic; calyptra mitriform.....*61. Physcomitrium*
  { Lid almost flat; calyptra cucullate.....*62. Funaria*

7 { Leaves ovate, oblong, or obovate, nerve usually excurrent.....8
  { Leaves lanceolate, linear, or subulate.....9

8 { Calyptra long, cylindric, covering capsule; leaves large, opaque, with large, multifid papillae.....*47. Encalypta*
  { Leaves smooth or with smaller papillae; calyptra small.....*39. Pottia*

9 { Plant minute, on stone; leaves subulate; smooth.....*13. Seligeria*
  { Leaves lanceolate or linear, usually papillose.....10

10 { Seta lateral; ls. strongly keeled, acute, nerve vanishing *48. Anoectangium*
   { Seta terminal .....*43. Weisia*

H. CAPSULE WITH APOPHYSIS AS WIDE AS OR WIDER THAN ITSELF.

1 { Apophysis little wider than the capsule; autoicous.....*55. Tetraplodon*
  { Apophysis much wider than the capsule; dioicous or autoicous *54. Splachnum*

I. CAPSULE MORE OR LESS STRIATE, REGULARLY FURROWED WHEN DRY (ACROCARPOUS).

1 { Capsule on an arcuate seta.....2
  { Seta straight (the capsule erect or oblique) 5

2 { Leaves ovate, with long, very lax cells.....*62. Funaria*
  { Leaves lanceolate or subulate, cells narrow.....3

  { Capsule subglobose; leaves papillose.....4
  { Capsule elongate; leaves smooth.....*24. Campylopus*

4 { Leaves squarrose, plicate.....*72. Breutelia*
Leaves spreading, not plicate.....*70. Bartramia*

5 { Capsule subglobose, oblique (erect in *Bartr. stricta*).....6
Capsule more or less oval or cylindric.....8

6 { Teeth of peristome united into a cone; branches 5-angled *69. Conostomum*
Teeth of peristome free.....7

7 { Leaves short; branches usually whorled.....*71. Philonotis*
Leaves long and narrow; branches not whorled.....*70. Bartramia*

8 { Teeth of (outer) peristome grouped in pairs or fours.....9
Teeth of peristome equidistant.....11

9 { Calyptra sub-persistent, large, mitriform, plicate, often hairy.....10
Calyptra soon falling, cucullate, smooth.....*49. Zygodon*

10 { Capsule much exserted, with superficial stomata; leaves crisped when dry (except *U. Hutchinsiae*), basal cells very narrow.....*50. Ulota*
Capsule usually less exserted, stomata immersed (except *O. speciosum*); ls. more or less imbricate when dry, basal cells wide...*51. Orthotrichum*

11 { Peristome single.....12
Peristome double.....19

12 { Peristome teeth 16, simple, or slightly and irregularly divided.....13
Peristome teeth 16, cloven half-way or more.....15

13 { Capsule long, covered by calyptra; leaves large and wide *47. Encalypta*
Capsule very short; leaves narrow.....14

14 { Leaves subulate, entire, with excurrent nerve.....*14. Brachyodus*
Leaves linear or ligulate, usually toothed, nerve vanishing *17. Rhabdoweisia*

15 { Leaves (apparently) nerveless, large, whitish *27. Leucobryum*
Leaves single-nerved.....16

16 { Peristome teeth divided to base.....*16. Ceratodon*
Peristome teeth divided half-way.....17

17 { Leaves with swollen, usually brownish, angular cells.....*26. Dicranum*
Leaves without special angular cells.....18

18 { Leaves crisped when dry, papillose, toothed above, cells short *18. Cynodontium*
Leaves rarely crisped, smooth, cells elongate (except *D. heteromalla*) *21. Dicranella*

19 { Capsule with spiral striae, erect.....*47. Encalypta*
Capsule without spiral striae, cernuous.....20

20 { Ls. coarsely toothed, cells of sheathing base long and narrow...*67. Timmia*
Ls. entire or finely toothed, not sheathing, basal cells little elongate *66. Aulacomnium*

J. CAPSULE SMOOTH, ERECT, PERISTOME TEETH 4-16, NEARLY SIMPLE.

1 { Peristome teeth 4 only.....*3. Tetraphis*
Peristome teeth 16.....2

2 { Leaves wide, with long, very lax cells.....3
Cells short, or elongate and narrow.....4

3 { Leaves strongly serrate, or entire and very obtuse.....*56. Tayloria*
Leaves almost entire, acute.....*62. Funaria*

4 { Peristome teeth strongly paired, reflexed when dry...*34. Glyphomitrium*
Peristome teeth not paired.....5

5 { Leaves subulate, smooth ; growing on stones or rocks.....6
Leaves more or less lanceolate, or wider, usually papillose.....7

6 { Plant minute ; angular cells of leaves not coloured.....*13. Seligeria*
Plant larger ; angular cells distinct, brownish.....*22. Blindia*

7 { Nerve excurrent (or leaves wide-ovate, obtuse, very concave).....8
Nerve ceasing in or below apex.....10

8 { Capsule long, cylindric ; ls. large, with large multifid papillae *47. Encalypta*
Capsule shorter, oval ; ls. smooth, or with smaller papillae.....9

9 { Leaves ovate-lanceolate, ovate, or obovate.....*39. Pottia*
Leaves linear-lanceolate or lanceolate.....*43. Weisia*

10 { Ls. blackish-green, opaque, bistratose above (alpine rocks)...*30. Grimmia*
Ls. not bistratose.....11

11 { Ls. wide at apex, serrate above.....*42. Leptodontium*
Ls. narrowed towards apex, almost entire.....12

12 { Perichaetial ls. distinct, sheathing ; ls. more or less coloured at angles *23. Dicranoweisia*
Perichaetial ls. not distinct ; angles not coloured.....*41. Barbula*

K. CAPSULE SMOOTH, ERECT, PERISTOME TEETH 16, DEEPLY DIVIDED, OR 32 (ACROCARPOUS).

1 { Peristome twisted.....2
Peristome straight.....4

2 { Ls. oblong or obovate, or covered with granular filaments...*40. Tortula*
Ls. more or less tapering in upper half, without granular filaments.....3

3 { Ls. usually short, or with recurved margins ; hyaline cells not ascending up margin.....*41. Barbula*
Ls. very long and narrow, with plane margins ; basal hyaline cells ascending up margin .....*44. Trichostomum*

4 { Basal cells long, narrow, nodulose.....*31. Rhacomitrium*
Basal cells not nodulose.....5

5 { Plant small, glaucous-green ; among alpine rocks.....*15. Saelania*
Plant not glaucous.....6

6 { Upper cells elongate.....7
Upper cells short, usually more or less quadrate.....8

7 { Nerve excurrent in the narrow subula.....*11. Ditrichum*
Nerve ceasing below apex.....*21. Dicranella*

8 { Nerve excurrent, angular cells brownish ; peristome teeth divided half-way .....*26. Dicranum*
Nerve not excurrent, angular cells not coloured ; peristome teeth usually divided nearly to base.....9

9 { Leaves more or less toothed above.....10
Leaves entire (unless at extreme apex).....11

10 { Leaves plicate.....*33. Ptychomitrium*
Leaves not plicate.....*18. Cynodontium*

11 { Leaf-margin recurved ; nerve not excurrent.....*41. Barbula*
Leaf-margin plane or incurved ; nerve excurrent (except *tenuirostre*) *44. Trichostomum*

L. CAPSULE INCLINED OR ON AN ARCUATE SETA, WITH SINGLE PERISTOME (ACROCARPOUS).

1 { Seta bent or curved downwards when moist.....2
  { Seta straight (except where it joins the capsule).....5

2 { Ls. with large inflated auricles, and long fine points...25. *Dicranodontium*
  { Ls. not auricled.....3

3 { Plant tall; nerve 2-winged at back.....30. *Grimmia*
  { Plant very small; nerve not winged.....4

4 { Nerve vanishing; peristome teeth narrow, usually cloven 35. *Campylostelium*
  { Nerve excurrent; peristome teeth lanceolate, usually entire 13. *Seligeria*

5 { Capsule sub-globose, horizontal..... 6
  { Capsule not globose.....7

6 { Plant almost stemless, with minute nerveless leaves...57. *Discelium*
  { Stem bearing numerous nerved leaves; capsule very small 68. *Catoscopium*

7 { Leaves with angular cells enlarged, usually brownish.....26. *Dicranum*
  { Leaves without special angular cells.....8

8 { Capsule with neck as long as itself.....20. *Trematodon*
  { Capsule without elongated neck.....9

9 { Ls. with upper cells elongate, smooth.....21. *Dicranella*
  { Upper cells more or less quadrate or hexagonal, scarcely elongate.....10

10 { Nerve distinctly excurrent.....40. *Tortula cernua*
   { Nerve vanishing..... 11

11 { Leaves smooth; capsule strumose.....18. *Cynodontium*
   { Leaves papillose; capsule not strumose.....19. *Dichodontium*

M. CAPSULE INCLINED OR PENDULOUS, WITH DOUBLE PERISTOME (ACROCARPOUS).

1 { Plant almost stemless, with minute nerveless leaves.....7. *Buxbaumia*
  { Leaves nerved 2

2 { Leaves linear-setaceous; plant small.....3
  { Leaves not setaceous.....4

3 { Capsule inclined, clavate.....74. *Orthodontium*
  { Capsule pendulous, pyriform.....75. *Leptobryum*

4 { Outer peristome much shorter than inner; ls. lingulate.....5
  { Outer peristome equalling inner.....6

5 { Leaves acute, cells lax.....63. *Amblyodon*
  { Leaves obtuse, cells narrow.....64. *Meesia*

6 { Cells truncate-hexagonal, lax; peristome curved spirally.....62. *Funaria*
  { Cells pointed or roundish; peristome not curved.....7

7 { Capsule very long-necked, mouth very oblique.....77. *Plagiobryum*
  { Capsule short-necked, or long-necked and regular.....8

8 { Leaves entire, obtuse (or sub-acute at most).....9
  { Leaves acute or acuminate, or less acute and serrate.....10

9 { Leaves large, over 1½ line, roundish.....79. *Mnium*
  { Leaves small, under 1 line.....78. *Bryum*

10 { Upper cells large, roundish-hexagonal; ls. large.....*79. Mnium*
Upper cells elongate, hexagonal-rhomboid.....11

11 { Cilia without appendages, nerve not excurrent, rarely reaching apex *76. Webera*
Plants with either appendiculate cilia, or excurrent nerve.....*78. Bryum*

N. LEAVES NERVELESS OR SHORTLY 2-NERVED, WITH SHORT CELLS (AT LEAST AT THE SIDES).

1 { Leaves strongly plicate when moist, acuminate.....*88. Leucodon*
Leaves not (or only very slightly) plicate when moist.....2

2 { Plant rather robust, leaves over ½ line long.....3
Plant very slender, leaves under ½ line long.....4

3 { Leaves serrate above, margin plane.....*89. Pterogonium*
Leaves entire, margin recurved.....*36. Hedwigia*

4 { Leaves finely serrulate, usually papillose.....*99. Heterocladium*
Leaves entire.....5

5 { Leaves acuminate, sub-squarrose, smooth.....*90. Habrodon*
Leaves not acuminate, more or less imbricate.....6

6 { Leaves sub-acute, smooth.....*91. Helicodontium*
Leaves obtuse or apiculate, more or less papillose.....*94. Myurella*

O. LEAVES NERVELESS OR 2-NERVED, WITH ELONGATED CELLS.

1 { Leaves falcato-secund.....*114. Hypnum*
Leaves not distinctly secund.....2

2 { Leaves covered at back with long papillae.....*98. Pterigynandrum*
Leaves smooth (or with a few small papillae near apex).....3

3 { Ls. very concave, imbricate, with long filiform apiculus...*104. Myurium*
Ls. without filiform apiculus.....4

4 { Ls. whitish, with cells in several layers.....*27. Leucobryum*
Ls. with cells in one layer only.....5

5 { Ls. obtuse, or widely and bluntly pointed, or apiculate.....6
Ls. acute or acuminate.....9

6 { Aquatic or marsh plant.....*114. Hypnum*
Terrestrial or rupestral plant.....7

7 { Stem and ls. pale; auricles of small, opaque cells...*103. Cylindrothecium*
Either the stem red, or the auricles of large, thin cells.....8

8 { Terrestrial plant .....*114. Hypnum*
Rupestral plant .....*111. Sematophyllum*

9 { Stem and branches red, often with paraphyllia; plant robust *115. Hylocomium*
Stem and branches not red.....10

10 { Leaves very minute; plant slender, conferva-like...*113. Amblystegium*
Leaves easily visible.....11

11 { Leaves wide-ovate, sharply serrate, with widish acumen *109. Hyocomium*
Leaves entire or nearly so, or with a long, finely serrulate acumen.....12

12 { Ls. more or less squarrose or recurved.....*114. Hypnum*
Ls. imbricate or sub-secund.....13

13 { Acumen serrulate .....*112. Plagiothecium*
Acumen entire or sub-denticulate only.....14

14 { Aquatic plants ; in streams, etc.....15
Plants not aquatic.....16

15 { Leaves either strongly 3-ranked, or very long and narrow...*81. Fontinalis*
Leaves not 3-ranked, not 3 times as long as wide.....*114. Hypnum*

16 { Ls. reddish, more or less plicate, at least when dry...*106. Orthothecium*
Ls. not reddish nor plicate.....17

17 { Alar cells few, suddenly much enlarged, hyaline ; lid longly rostrate *111. Sematophyllum*
Alar cells numerous, less distinct, lid shorter.....18

18 { Ls. ovate below ; capsule erect, lid conic.....*105. Pylaisia*
Ls. lanceolate ; capsule cernuous, or erect with rostrate lid...*114. Hypnum*

P. PLANT WITH GEMMAE OR FILAMENTS ON THE LEAVES OR ON SPECIAL RECEPTACLES.

1 { Plant with special stalked receptacles.....2
Plant without such receptacles.....3

2 { Gemmae in stalked roundish heads.....*66. Aulacomnium*
Gemmae in terminal leafy cups.....*3. Tetraphis*

3 { Gemmae collected at the end of the nerve.....4
Gemmae or filaments on the surface of the leaf or nerve.....5

4 { Leaves entire .....*50. Ulota*
Leaves serrate.....*42. Leptodontium*

5 { Appendages confined to the (often dilated) nerve.....*40. Tortula*
Appendages scattered over the face of the leaf.....*51. Orthotrichum*

Q. NERVE WIDE, ABOUT ONE-THIRD OF THE BASE OF LEAF.

1 { Ls. with subulate points, mostly formed by the nerve.....2
Ls. lanceolate, nerve not reaching apex.....*93. Porotrichum*

2 { Ls. with coloured or dilated angular cells.....3
Ls. without special angular cells.....5

3 { Ls. suddenly narrowed above base to a long subula.....4
Ls. more gradually subulate.....*24. Campylopus*

4 { Basal auricles of ls. large and inflated.....*25. Dicranodontium*
Basal auricles slightly developed or absent.....*26. Dicranum*

5 { Ls. secund ; upper cells not much elongate.....*21. Dicranella*
Ls. spreading ; upper cells very long and narrow.....*75. Leptobryum*

R. CELLS WIDE, 20 μ OR MORE IN THEIR SHORTEST DIAMETER.

1 { Cells short, quadrate or roundish.....2
Cells elongate.....5

2 { Nerve excurrent.....*39. Pottia*
Nerve vanishing below apex.....3

3 { Leaves serrate .....*79. Mnium*
Leaves entire.....4

4 { Leaves very large, roundish.....*53. Oedipodium*
Leaves oblong.....*51. Orthotrichum*

5 { Cells mostly with pointed ends.....6
  { Cells flattened at the ends (or leaves large, wide, and flaccid).....8

6 { Ls. small, closely imbricate, green or pinkish.....*77. Plagiobryum*
  { Ls. rarely imbricate, or imbricate and silvery white.....7

7 { Ls. usually narrow, nerve not reaching apex.....*76. Webera*
  { Ls. usually wider, nerve often reaching apex or excurrent *...*78. Bryum*

8 { Leaves ending in long fine points.....*55. Tetraplodon*
  { Leaves without such points.....9

9 { Leaves obtuse and entire.....10
  { Leaves acute.....11

10 { Leaves ovate or roundish.....*54. Splachnum*
   { Leaves lingulate.....*56. Tayloria*

11 { Leaves narrow, serrate near apex.....*63. Amblyodon*
   { Leaves wide, ovate or obovate **.....*62. Funaria, &c.*

8. LEAVES OBTUSE AND ENTIRE, OR BLUNTLY APICULATE.

1 { Basal cells long and narrow, strongly nodulose.....*31. Rhacomitrium*
  { Basal cells not nodulose, at most sinuose only.....2

2 { Upper cells short, more or less quadrate or roundish.....3
  { Upper cells elongate.....10

3 { Branches pinnate or bipinnate, rolled up closely when dry...*97. Leptodon*
  { Branches not rolled up when dry.....4

4 { Leaves narrow, very short, not $\frac{1}{2}$ line long.....*43. Weisia*
  { Leaves over $\frac{1}{2}$ line long.....5

5 { Ls. pale, yellowish, pellucid ; upper cells sinuose.....*66. Aulacomnium*
  { Ls. dark-green, more or less opaque ; cells not sinuose (except *Grimmia*)..6

6 { Leaves obovate-spathulate.....*40. Tortula*
  { Leaves more or less ovate, lingulate or lanceolate.....7

7 { Stem stoloniform, much interlaced, with erect branches...*96. Anomodon*
  { Stem not stoloniform.....8

8 { Leaves over two lines long.....14
  { Leaves under two lines long.....9

9 { Cells quadrate, sometimes sinuose.....*30. Grimmia*
  { Cells rounded.....*51. Orthotrichum*

10 { Leaves strongly squarrose-recurved.....*21. Dicranella*
   { Leaves not markedly squarrose.....11

11 { Cells with flattened ends ; ls. narrow-lingulate.....*64. Meesia*
   { Cells with pointed or overlapping ends.....12

12 { Leaves very large (over 2 lines), roundish.....*79. Mnium*
   { Leaves smaller.....13

13 { Plant acrocarpous, erect ; cells usually rather wide.....*78. Bryum*
   { Plant pleurocarpous, rarely erect ; cells very narrow.....*114. Hypnum*

14 { Leaves wide, ovate, with coarse, multifid papillae.....*47. Encalypta*
   { Leaves narrow, lingulate ; nerve broad, often indistinct...*8. Diphyscium*

* See also under *Webera*, p. 330.

** This would include several species of *Physcomitrium*, *Funaria*, *Splachnum*, *Tetraplodon*, and *Tayloria*, hardly to be identified by a Key in the absence of fruit.

T. LEAVES WITH ENLARGED (OFTEN BROWNISH) ANGULAR CELLS (ACROCARPOUS).

1 { Leaves serrate above.....*26. Dicranum*
Leaves entire, or finely serrate at apex only.....2

2 { Cells short, more or less quadrate.....3
Cells elongate.....*22. Blindia*

3 { Ls. much crisped when dry ; plant small.....*23. Dicranoweisia*
Ls. not or only slightly crisped.....*26. Dicranum*

U. LEAVES WITH EXCURRENT NERVE, OR WITH LONG, FINE SUBULATE POINTS INTO WHICH THE NERVE RUNS.

1 { Cells not twice as long as wide, usually quadrate or roundish.....2
Cells elongate, or with pointed ends.....13

2 { Ls. toothed in upper part, or with long, fine, denticulate subula.....3
Ls. entire in upper part, or with a few teeth at apex only.....7

3 { Ls. short, glaucous, mealy-looking ; plant small.....*15. Saelania*
Ls. not glaucous, or else long and narrow.....4

4 { Ls. papillose, long and narrow, spreading or erect.....*70. Bartramia*
Ls. smooth, squarrose or secund.....5

5 { Ls. subulate-setaceous, secund.....*11. Ditrichum*
Ls. ovate or lanceolate, squarrose.....6

6 { Ls. with pale zone at margin and wide apex.....*42. Leptodontium*
Ls. without pale margin, tapering to narrow apex.....*45. Pleurochaete*

7 { Cells rounded, incrassate ; ls. short.....*49. Zygodon*
Cells more or less quadrate or oblong.....8

8 { Leaves more or less ovate, or obovate, or large and oblong.....9
Leaves ovate-lanceolate, lanceolate, or linear.....10

9 { Ls. large, opaque with coarse, multifid papillae.....*47. Encalypta*
Ls. smooth or finely papillose*.....*40. Tortula*

10 { Margin usually incurved ; ls. more or less lanceolate or ovate-lanceolate 11
Margin plane or recurved.....12

11 { Ls. more or less toothed at apex, not red below.....*16. Ceratodon*
Ls. entire at apex, or toothed with the lower ones red.....*41. Barbula*

12 { Ls. glaucous, serrate near base, entire above.....*43. Weisia*
Ls. entire below (or slightly crenulate near base only)**.*44. Trichostomum*

13 { Ls. papillose, serrate.....14
Ls. smooth.....15

14 { Ls. very long and narrow ; branches not whorled.....*70. Bartramia*
Ls. shorter and wider ; branches often whorled.....*71. Philonotis*

15 { Ls. subulate ; cells narrow-oblong***.....*21. Dicranella*
Ls. ovate or lanceolate ; cells rhomboid.....*78. Bryum*

* This would also include some species of *Pottia*, not likely to be gathered without fruit.

** This would include some species of *Weisia*, mostly with involute leaf-margin, but hardly likely to be gathered without fruit.

*** Including *Ditrichum*, hardly to be distinguished without fruit.

V. LEAVES WITHOUT EXCURRENT NERVE (ACROCARPOUS).

1 { Leaves with basal cells sinuose or nodulose....2
  { Basal cells not sinuose nor nodulose....3

2 { Basal cells very long and narrow, nodulose....*31. Rhacomitrium*
  { Basal cells shorter, sinuose, or else nerve 2-winged at back above *30. Grimmia*

3 { Cells elongate or pointed at the end....4
  { Cells short, usually quadrate or rounded....12

4 { Leaves squarrose, plicate....*72. Breutelia*
  { Leaves not squarrose....5

5 { Leaves papillose....6
  { Leaves smooth....8

6 { Leaves small, closely imbricated in 5 ranks....*69. Conostomum*
  { Leaves larger, not conspicuously 5-ranked....7

7 { Ls. ovate or ovate-lanceolate; branches often whorled...*71. Philonotis*
  { Ls. long, lanceolate or linear; branches not whorled....*70. Bartramia*

8 { Ls. almost setaceous, very narrow....9
  { Ls. not setaceous....10

9 { Ls. sharply serrulate near apex; nerve wide below....*75. Leptobryum*
  { Ls. bluntly toothed; nerve narrow; cells wider....*74. Orthodontium*

10 { Ls. usually lanceolate; nerve not reaching apex**....11
   { Ls.usually ovate; nerve often reaching apex ....*78. Bryum*

11 { Tufts very dense and compact; ls. very small....*73. Oreas*
   { Tufts usually looser; ls. larger....*76. Webera*

12 { Leaves toothed in the whole upper part....13
   { Leaves entire, or toothed near apex only....22

13 { Leaves plicate ....*33. Ptychomitrium*
   { Leaves not plicate....14

14 { Leaves squarrose, more or less recurved....15
   { Leaves not squarrose....19

15 { Ls. sub-acute or somewhat obtuse, strongly papillose...*19. Dichodontium*
   { Ls. acute, smooth or finely papillose....16

16 { Ls. short, ovate or oblong....17
   { Ls. lanceolate or linear....18

17 { Stem tall, tomentose; ls. widely ovate....*65. Paludella*
   { Stem short; ls. oblong....*42. Leptodontium*

18 { Cells small, rounded....*49. Zygodon*
   { Cells more or less quadrate or oblong....*70. Bartramia*

19 { Leaves sharply papillose.... 6
   { Leaves smooth or obscurely papillose....20

20 { Ls. long (3 lines), coarsely toothed, incurved when dry....*67. Timmia*
   { Ls. shorter, crisped and twisted when dry....21

21 { Ls. linear or ligulate, with rather blunt points....*17. Rhabdoweisia*
   { Ls. linear-lanceolate, tapering to narrow points....*18. Cynodontium*

22 { Cells rounded, or irregular and pellucid....23
   { Cells more or less regularly quadrate....26

23 { Leaves short, scarcely ½ line long....*49. Zygodon*
   { Leaves longer, usually over 1 line long....24

** See also under *Webera*, p. 330.

24 { Ls. dark-green, rigid and imbricate when dry.....*51. Orthotrichum*
Ls. usually paler, more or less crisped when dry.....25

25 { Ls. with narrow points; base dilated, unistratose.....*50. Ulota*
Ls. with rather wide points; base not dilated, bistratose *66. Aulacomnium*

26 { Nerve broad, ill-defined; ls. narrow-lingulate, of 2-3 layers of cells *8. Diphyscium*
Nerve well-defined..... 27

27 { Plants in deep, dense tufts among rocks; ls. usually linear or linear-lanceolate 28
Plants short, or loosely tufted; ls. usually lanceolate, with the margin recurved, at least in part.....31

28 { Tufts very compact, bright green above; ls. rather short *48. Anoectangium*
Leaves long and narrow; tufts less compact.....29

29 { Ls. acute; cells minute, rather opaque.....30
Ls. sub-acute or acute with pellucid cells.....*43. Weisia*

30 { Ls. curled up or merely flexuose when dry; nerve not glossy at back when dry.....*49. Zygodon*
Ls. long, much crisped and twisted when dry; nerve usually glossy at the back..... .....*44. Trichostomum*

31 { Nerve reaching the more or less toothed apex.....*16. Ceratodon*
Apex entire, or else the nerve vanishing below it.....*41. Barbula*

W. PLEUROCARPOUS MOSSES WITH NERVED LEAVES AND SHORT CELLS.

1 { Stem covered with green paraphyllia, markedly pinnate...*101. Thuidium*
Stem without paraphyllia.....2

2 { Ls. serrate above; plant tall, dendroid, rigid.....*93. Porotrichum*
Ls. entire, or toothed near apex only.....3

3 { Ls. more or less toothed near apex.....*100. Pseudoleskea*
Ls. entire throughout.....4

4 { Nerve ceasing about ½ or ⅔ up the leaf.....5
Nerve reaching nearly or quite to apex.....7

5 { Ls. ovate, over ½ line long.....*82. Cryphaea*
Ls. minute; plant very slender.....6

6 { Ls. imbricate, papillose, cells very small.....*100. Pseudoleskea*
Ls. sub-complanate, smooth, cells larger.....*91. Helicodontium*

7 { Primary stem stoloniform, with minute leaves.....*96. Anomodon*
Stem not stoloniform.....*95. Leskea*

X. PLEUROCARPOUS MOSSES WITH NERVED LEAVES AND LONG CELLS.

1 { Ls. strongly papillose at back, without distinct auricles.....2
Ls. smooth or nearly, or papillose with distinct auricles.....3

2 { Stem markedly pinnate, with paraphyllia.....*101. Thuidium*
Stem irregularly branched, slender.....*98. Pterigynandrum*

3 { Ls. with sharp, recurved teeth at apex, margin revolute...*92. Antitrichia*
Ls. without recurved teeth at apex.....4

4 { Stem dendroid, bare below, branched above.....5
  { Stem not strikingly dendroid.....6

5 { Ls. rather obtuse, serrate, plicate.....*102. Climacium*
  { Ls. not plicate, more or less acute, serrulate only.....*110. Eurhynchium*

6 { Leaves either transversely rugose, or on a red stem clothed with paraphyllia .....*115. Hylocomium*
  { Plant without either of these characters.....7

7 { Leaves uniformly falcato-secund.....*114. Hypnum*
  { Leaves not falcato-secund.....8

8 { Cells rarely more than 2-5 times as long as wide.....9
  { Cells long and narrow.....10

9 { Leaves entire or nearly so, or with a nerve reaching high in the acumen *113. Amblystegium*
  { Leaves serrulate, at least near apex.....*110. Eurhynchium*

10 { Ls. plicate, with long, narrow acumen, more or less imbricate.....11
   { Ls. not plicate, or plicate with shorter points.....12

11 { Capsule erect, or inclined and curved; cells narrow-linear, almost to base of leaf..... *107. Camptothecium*
   { Capsule always inclined and curved; cells more rhomboid, wider towards base of leaf.....*108. Brachythecium*

12 { Ls. either with distinct swollen auricles, or else more or less squarrose and entire* .....*114. Hypnum*
   { Ls. not conspicuously auricled, not squarrose and entire.....13

13 { Stem often pinnate** ..... *110. Eurhynchium*
   { Stem irregularly branched**..... *108. Brachythecium*

* This would include *H. riparium*, the leaves of which are not auricled, and are scarcely squarrose, though widely divergent and straight when dry.

** See also the introductory remarks to these genera.

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CLASS MUSCI.

SUB-CLASS I. SPHAGNALES.

Spores not developed from the Endothecium, but from a distinct layer of cells, the Amphithecium. Columella developed from the Endothecium, not penetrating the spore-bearing layer. Capsule opening by a lid.

Order I. SPHAGNACEAE.

The Sphagnaceae differ so widely from the rest of the mosses that they are by many authorities not even considered to be mosses at all in the strict sense of the word. In the fasciculate arrangement of the branches, in the cell structure of the leaves, and in the absence, except in the young state, of rootlets, their vegetable morphology has no parallel among the mosses, while the structure of the reproductive organs, both male and female, serves still further to widen the gap.

If, however, the differences which separate them from the other mosses are striking, the points of resemblance are no less so, and a work which treats of the mosses in general and omits the Sphagnaceae, can hardly avoid giving a sense of incompleteness.

The plants belonging to this order are comprised within a single genus. They are usually found in dense masses or cushions in bogs or on wet moorlands, where they often form the prevailing and the distinctive feature of the vegetation; more rarely on the brink of mountain streams or in the clefts of rocks.

The stem is usually erect and thread-like, the erect position being only maintained by the crowded condition of the plants. It is composed of two forms of tissue, a central cylinder or axis, usually coloured, and having the outer layers of its cells often more or less tough and hard; this is surrounded by a cuticular sheath of from one to four layers of larger hyaline cells with thin walls; these, however, are not always easily distinguishable from the outer layers of the central axis. The cuticular sheath of the branches usually has in addition an outer series of flask-shaped cells, the *retort* cells, slightly narrowed above into a neck, which is frequently more or less recurved from the branch; this is markedly the case in *S. tenellum*.

The stem leaves are thin and fragile, differing in form and structure from those of the branches. The branches are in fascicles of from 3 to 12, generally of two forms, some being *pendent* and more or less appressed to the stem, usually longer and more flagelliform than the others, which are *divergent*, more spreading or even ascending, and for the most part stouter, with shorter and broader leaves. The branches at the apex of the stem are as a rule more densely crowded and shorter, forming a more or less compact head, the *capitulum*.

The areolation of the branch leaves is very remarkable. It consists of a single layer of cells of two forms, alternating with one another; the true cells being very narrow, more or less chlorophyllose, and almost hidden between the larger ones, the utricles or hyaline cells, which are usually sinuosely elliptical or rhomboid, and with rare exceptions contain spiral fibres or more accurately spiral thickenings of the cell walls; the walls are also perforated by rounded pores. The stem leaves differ in their tissue, being entirely composed of hyaline cells, possessing much fewer fibres and pores, which may indeed be altogether absent.

The antheridia are remarkably like those of the foliose Hepaticae, and are hardly approached in structure among the mosses, except perhaps in Buxbaumia. They are stalked, globular, and lie singly in the axils of the bracts, usually at the apex of specialised branches of the capitulum. The paraphyses are very finely capillary, and are branched.

The female flower is formed as a bud on the stem in the axil of one of the upper fascicles. After fertilisation the perichaetial bracts elongate, so as to give the whole the appearance of a short lateral branch, while the basal part of the sporogonium, which may be termed the vaginula, elongates rapidly into a "pseudopodium" upon which the ripening sporangium is elevated above the perichaetial bracts. The mature capsule is almost uniform in all species of Sphagnum, of a chestnut brown, globose or elliptical, with a flattish or convex lid which separates suddenly at maturity by contraction of the walls of the capsule. The calyptra is very delicate, and is irregularly torn in separating from the vaginula by the growth of the sporogonium.

In colour the various species of Sphagnum vary from white through all shades of pink and reddish brown to a rich deep red, and through every tint of green and greenish yellow to a bright grass green. In shady situations green is the prevailing tint; in the open the red tints frequently preponderate, owing to the formation of tannin. Within certain limits the colour may be looked upon as a character of importance in distinguishing species, and it is a curious fact that in forms of *S. acutifolium* growing in shady places, while the rest of the plant is entirely green, the male amentula invariably show traces of red. When dry the

plant loses much of its green hue, presumably on account of the much greater shrinking of the contents of the chlorophyllose cells in proportion to that of the empty colourless hyaline ones.

The length to which the stem of a Sphagnum plant may grow is practically indefinite. When growing loosely in ditches or deep pools the stems are sometimes gathered several feet long; Wilson mentions a specimen seven feet in length from near Edinburgh. As a rule, however, and especially when growing on drier ground, where growth is slower and exposure to the air renders decay more rapid, the lower part of the stem becomes fragile and decomposed as rapidly as the apical part elongates, and from the more compact forms it is often difficult to obtain unbroken specimens of more than a few inches in height, although below this there may be a considerable depth of substance composed entirely of remains of the Sphagnum plant. The lengths given in the descriptions of the different species must, therefore, be looked upon only as affording a rough means of comparison between species, not as an indication of the maximum height they may attain.

The structure of the cell tissue, as well as the general arrangement of the parts of the Sphagnum plant, renders it particularly adapted to the absorption and conduction of water. Thus, if a plant or a tuft of Sphagnum is placed in water, the latter is very rapidly soaked up and distributed over the whole plant, from the surface of which it can easily pass by evaporation and transpiration. In this way extensive tracts of watery country have been "drained" of their moisture, while at the same time the surface has been raised by the constantly accumulating debris of decayed tissue at the base of the plants, thus becoming accessible to and habitable by mankind. The mass of vegetable detritus so formed, when compressed by the weight of growth above it, is often changed into peat; hence the name of Peat-Moss by which the family of Sphagnaceae is commonly known.

The position and form of the chlorophyllose cells of the branch leaves is of considerable importance in the determination of species. This is best ascertained by cutting thin transverse sections; but their position, whether dorsal or ventral, may often be ascertained more simply by careful focussing of the leaves, both back and front, with a high power. When the chlorophyllose cell emerges on either side of the leaf, it will appear, viewed from that side, to lie between the two adjacent hyaline cells, the spiral fibres of which will thus be seen to spring from *two separate lines*, the sides of the chlorophyllose cell, *between which* the coloured contents of the latter are visible (cf. Tab. II. D. 2cv.). When, on the other hand, the chlorophyllose cell is enclosed on either face of the leaf by the hyaline cells, the latter, when viewed from that side, will appear to meet in a thin line above the chlorophyllose cell, in

such a manner that their spiral fibres appear to spring from this *single median line, on each side* of which may be seen (on focussing slightly down) the coloured contents of the subjacent chlorophyllose cell (cf. Tab. II. D. 2cd.).

Since the publication of the 1st edition of this work, an important contribution to the study of our Sphagna has appeared in the Journal of Botany, in a series of papers by Mr. E. Ch. Horrell—"The European Sphagnaceae (after Warnstorf)"—giving the latest views of Dr. Warnstorf on the group. The number of British species under that arrangement is raised to 40, the division into species being based very greatly upon the arrangement of the pores in the branch leaves and the form and position of the chlorophyllose cells. A more recent publication on similar lines is the "Synopsis of the European Sphagna," by J. A. Wheldon, where the number of species—following Warnstorf's latest arrangement—is raised to 59. After careful consideration, I have decided not to adopt that system ; the subject does not admit of adequate discussion here, but I may say that I have been principally guided to that conclusion by the fact that in my own experience, and in that of several correspondents, the species as defined by Warnstorf do not seem, in several of the sections at least, to correspond in practice with a natural grouping of the plants themselves. In the Acutifolia Section the classification does, however, appear to me to present points of considerable improvement on the older systems, although I cannot look upon Warnstorf's species as properly holding that rank ; and I have adopted his grouping of these forms in the place of the varieties of the previous edition, but treating his species as varieties of *S. acutifolium*.

Some valuable papers on Sphagnum have recently appeared in the Bryologist, vols. xiv.–xvi., by Dr. A. le Roy Andrews.

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1. **SPHAGNUM** Dill.

The only genus.

DERIV. σφαγνος (*sphagnos*).—An old Greek name for some plant now indeterminate, applied to this genus by Dillenius.

Two points require special notice with regard to the following Key. At No. 7 the beginner should not shirk the examination of the stem. It is not a question of elaborate section cutting, the roughest slice chopped off on the slide with a knife will show at once whether it has the single, well-defined layer of cuticle or not, and will save him from puzzling over one of the many deceptive forms of *S. subsecundum*. At No. 8 there is no need (as pointed out above in the text) for a section, but it is *always* necessary to examine *both the front and the back of a leaf* (it need not be, of course, the same leaf) with a fairly high power. The actual amount of emergence of the chlorophyll cells varies much, even in the same species, and it is often impossible to determine from the aspect of one surface what the opposite surface will be like. But the distinction made use of in the Key can always be made out, and is a safe and reliable guide among these difficult forms.

1 { Branch ls. broad, cucullate, rough back of apex with projecting cell-walls..2
Branch leaves not rough, not (or scarcely) cucullate.....5

2 { Plant pale-green or purplish ; cells with smooth walls.....3
Plant usually ochraceous ; cell-walls papillose.....4

3 { Chlorophyll cells free on ventral surface.....*1. cymbifolium*
Chlorophyll cells very small, elliptic, median, completely enclosed
1. medium*

4 { Papillae minute, conical ; chlor. cells oval or trapezioid in section
1. papillosum*
Papillae long, linear ; chlor. cells triangular in section.....*2. Austini*

5 { Stem ls. widest at the broad, strongly fringed apex 6
Stem ls. wider at base or middle than at apex 7

6 { Stem ls. fringed at end and sides of the rounded summit.....*8. fimbriatum*
Stem ls. fringed only across the truncated apex .....*9. Lindbergii*

7 { Stem-cuticle of one layer of cells only, very distinct.....*4. subsecundum*
Stem-cuticle of more than one layer, or indistinct.....8

8 { Chlorophyll cells conspicuously more free on ventral surface than on dorsal 9
Chlor. cells central, or more free on dorsal surface than on ventral.....11

9 { Branch ls. toothed at margin near apex ; stem ls. large, scarcely bordered .....*6. molle*
Branch ls. not toothed on margin ; stem ls. (usually) broadly bordered towards their base.....10

10 { Plant usually reddish ; stem ls. pointed or rounded, usually toothed at apex .....*7. acutifolium*
Plant pale ; stem ls. truncate, fringed .....*7*. Girgensohnii*

11 { Stem ls. with narrow border (or none), scarcely wider below 12
Stem ls. with broad border, which is widened towards base 14

12 { Branch ls. tapering to narrow points ; stem ls. lingulate 13
Branch ls. with wide, obtuse points (vars. of) .....*4*. laricinum*

13 { Branch ls. recurved at apex only ; stem cuticle in 3 or 4 layers... *5. teres*
Branch ls. recurved from middle ; cuticle in 2 layers.....*5*. squarrosum*

14 { Branch ls. large, ovate-oblong, broadly truncate and coarsely toothed at apex, chlor. cells enclosed ; stem ls. very short.....*3. rigidum*
Branch ls. tapering ; chlor. cells emerging at least on dorsal surface.....15

15 { Hyaline cells of branch ls. only 3 or 4 times as long as wide .. *12. tenellum*
Hyaline cells 6–12 times as long as wide.....16

16 { Stem leaves obtuse and more or less fringed at apex ; branch ls. not flattened when dry..... *4*. laricinum*
Stem ls. more or less pointed and toothed at apex, or cloven and erose ; branch ls. usually flattened when dry 17

17 { Pendent branches none or few ; stem cuticle distinct.....*11. cuspidatum*
Pendent branches concealing the stem ; cuticle (usually) indistinct ... 18

18 { Stem ls. small, apex pointed, usually toothed .....*10. intermedium*
Stem ls. larger, deeply cleft and fimbriate at apex ; plant robust
10. riparium*

A.—CYMBIFOLIA.

Plants *robust*. Cuticular cells of stem and branches *fibrose and porose*. Stem leaves *not bordered*. Branch leaves* *broadly cymbiform*, concave, *cucullate and scabrous* at back of apex. Dioicous.

* In the descriptions of Sphagnum, the term "branch leaves" refers to those of *divergent* branches.

1. Sphagnum cymbifolium Ehrh. (Tab. I. A.).

Robust. Height 6–8 inches. *Pale greenish white*, frequently with a tinge of purple. Cuticular cells of stem in 3–5 layers, fibrose and porose. Stem leaves *broadly lingulate-spathulate;* sometimes with a few fibres and pores, but usually without; *broadly rounded at summit*, the margin of the upper part, and sometimes of the whole leaf, *fimbriated* from erosion of the marginal cells. Divergent branches *tumid*, the leaves broadly ovate, somewhat narrowed to the cucullate apex; finely serrulate above, margined only with a single row of very narrow cells, often rendered absent by erosion. Hyaline cells rather large, with large pores; the walls *smooth*. Chlorophyllose cells in section *narrowly oval-triangular*, on the *ventral face* of the leaf, hardly reaching the dorsal face, but somewhat variable in both form and position.

Var. β. *squarrosulum* Nees & Hornsch. *Deeper green.* Branch leaves more *pointed, patulous;* those of the comal branches *squarrose.*

Var. γ. *congestum* Schp. Short; *densely tufted;* variously tinted. Upper cells of stem leaves often *fibrose*. Branches *short*, thick, obtuse; the leaves *closely imbricated.*

HAB. Bogs and sides of streams and pools, common. The var. β in woods and by the borders of pools. The var γ on drier moors.

Sphagnum cymbifolium in its typical form is not likely to be confused with any other species but *S. papillosum*, *S. Austini*, and *S. medium*, from which it can hardly be certainly distinguished without microscopic examination. It has, however, less often the yellowish-brown tinge of *S. papillosum*, which is also a more rigid plant.

S. Austini frequently forms dense, swollen cushions or tussocks, and is less frequently found in lowland districts; *S. medium* has usually, with us at least, a tinge of red; but microscopic examination is needed for certain determination. The following species (as described by Warnstorf) have been recorded from Britain.

S. turfaceum Warnst. has the chlorophyllose cells broadly triangular, or trapezioid, and the branch leaves more or less squarrose as in var. β.

S. degenerans Warnst. is an aquatic and perhaps abnormal form, with few branches, wide chlorophyllose cells, and stem cortex scarcely fibrose.

S. centrale Jens. (*S. subbicolor* Hampe) is a robust large leaved plant, closely resembling *S. cymbifolium* in outward characters, but with the chlorophyllose cells extremely narrow, very variable in position, sometimes free on both surfaces of the leaf, but occasionally enclosed almost as in *S. medium*.

The robust habit with large tumid branches will distinguish *S. cymbifolium* almost at first sight from most of the other species. The vars. might be taken, the one for a form of *S. squarrosum*, the other for *S. rigidum* var. *compactum;* but a little attention to the form of the leaves will soon dispel all doubt.

It may be noted here, with reference to the fibrose cells of the stem leaves in the var. *congestum*, that this character usually prevails in the more compact forms of the various species. As the function of the fibres is supposed to be to maintain the form of the cell by the additional support they give to the cell wall, their presence in greater numbers would naturally be looked for in those forms whose dense growth submits the cells to greater pressure.

*** Sphagnum medium** Limpr. (Tab. I. B.).

Closely resembling *S. cymbifolium*, but in the British forms at least more frequently tinged with red. Chlorophyllose cells *small, elliptical* in section, *central and completely enclosed* on both faces of the leaf by the hyaline cells.

HAB. Moors, chiefly in mountainous regions. First detected by Braithwaite near Loch Lomond in 1896, and since then recorded from several British stations.

S. medium may generally be recognised in the field by its reddish tinge, and in leaf-section it is very distinct, although according to Russow it occasionally differs very little, even in this character, from *S. cymbifolium*.

*** Sphagnum papillosum** Lindb. (*S. cymbifolium* var. *papillosum* Schp. Syn.) (Tab. I. C.).

Differs from *S. cymbifolium* in the plant being usually of an *ochraceous* tinge, without trace of purple; in the more *rigid* and more *obtuse* branches, and especially in the walls of the hyaline cells of the branch leaves, where they adjoin the chlorophyllose, being almost always *more or less covered with small conical papillae*. The chlorophyllose cells are usually more central, less distinctly nearer the ventral surface of the leaf. The upper part of the branch leaves is also less frequently narrowed, giving the whole a broader and rounder outline, and the margin is somewhat more distinctly serrulate.

Var. β. *confertum* Lindb. More *compact*, with *shorter* and *denser* branches. Branch leaves rounded, obtuse, very concave.

Var. γ. *stenophyllum* Lindb. Branch leaves *narrower, ovate-oblong*, less concave and almost entire above.

HAB. Peat bogs and ditches. Common. The var. β in drier places.

I have no hesitation in sinking *S. papillosum* to a sub-species of *S. cymbifolium*, with Cardot and other authors. The papillae on the cell walls are often reduced to a minute size, and moreover are entirely absent in plants which otherwise exactly resemble typical *S. papillosum* (vars. *sublaeve* Warnst. and *laeve* Warnst.). If we consider the latter form as belonging to *S. cymbifolium*, we must admit that the points of distinction derived from characters other than the papillae are valueless, and the distinction must rest on the papillae alone. And since there are forms (var. *sublaeve* Warnst.) in which the papillae are extremely minute and are even found only in the basal cells of the leaves, while wanting in the middle and upper part of the leaf, it seems clear that this character alone cannot be held to give full specific rank. I have specimens of both the above vars. from N. America, which have the distinctive look of *S. papillosum*, but with the papillae almost absent in the one and entirely wanting in the other. In the latter case it becomes, of course, a question to which of the two plants it should be referred. The fact that minute papillae have also been recently found in some forms of *S. squarrosum* and other species, and that *S. medium* Limpr. has the walls sometimes smooth and sometimes papillose, considerably minimises the value of these structures as specific characters.

I do not find the outer layers of the cuticular cells of the stem free from fibres, as Braithwaite describes them, though usually not so strongly fibrose as in *S. cymbifolium*. The inner ones are strongly fibrose.

The chlorophyllose cells are usually more or less emergent on the ventral surface, but sometimes enclosed on both faces.

2. Sphagnum Austini Sull. (Tab. I. D.).

Habit and colour of *S. papillosum*, but *less rigid*. Walls of the hyaline cells, adjoining the chlorophyllose, *thickly studded with linear papillae*, much longer than those of the former plant. Chlorophyllose cells on the *ventral* surface, more entirely covered by the hyaline on the dorsal face, *broadly triangular in section*.

Var. *β. imbricatum* Lindb. In *dense* tufts of a darker brown; branches crowded, with *closely imbricated* leaves.

HAB. Wet heaths and bogs, especially near the coast; rare. The var. *β* in almost the same localities as the type.

There seems somewhat more reason for according this plant the full specific rank, partly on account of the greater distinctness of the papillae, which however tend to be greatly reduced in some forms, and partly because of the difference in the chlorophyllose cells, which are wider, and more distinctly free on the ventral surface than in *S. papillosum*. The division of the Sphagna into species must of necessity be based on more or less arbitrary grounds. It appears most satisfactory to consider it a principle in their classification, that when two types, in themselves not very strongly distinct, are also united by a fairly well graduated series of intermediate forms, they should be re-united as species and sub-species. This is certainly the case with *S. cymbifolium* and *S. papillosum*; but is less clearly established in the case of the former species and *S. Austini*, and I have therefore kept them apart.

The papillae in *S. papillosum* are usually not much higher than broad; in *S. Austini* their height is frequently many times their breadth, and they have the appearance of imperfectly developed fibres.

B. TRUNCATA.

Outer cuticular cells of stem *without fibres*; pores none or few. Stem leaves *bordered* with narrow cells. Branches straight, *closely set*. Branch leaves *large*, more or less *oblong*, at apex *broadly truncate* and strongly toothed; the margin usually involute for almost the whole length. Chlorophyllose cells nearer the dorsal surface or sub-central, enclosed on both surfaces, rarely free at back of leaf. Monoicous.

3. Sphagnum rigidum Schp. (*S compactum* var. *rigidum* Nees) (Tab. I. E.).

Densely tufted, rigid; the divergent branches of equal length, *short, stiff, obtuse, closely set*. Plants of a greyish green or brownish colour. Height 4–9 inches. Stems dark brown. Stem leaves *very small*, inserted obliquely, *triangular-lingulate, rounded at the apex and eroded, bordered with several rows of narrow cells* occupying a considerable proportion of the width of the leaf. Leaves of

divergent branches *ovate-oblong*, slightly cucullate in the natural state, but truncate at apex when pressed flat and examined under the microscope, with 5–7 teeth. Hyaline cells wide but rather short, with unequal but somewhat large pores. Chlorophyllose cells *sub-central*, nearer the dorsal surface, narrow elliptical in section, enclosed at back and front by the hyaline. Antheridia on the pendent branches, not on specially differentiated ones.

Var. *β. compactum* Schp. (*S. compactum* De Cand.). Short, *very compact*, with short, thick branches; usually tinged with brown or red; the branch leaves somewhat shorter and rounded at apex.

Var. *γ. squarrosum* Russ. Looser. Branches usually more distant; branch leaves more or less *squarrose*.

HAB. Heaths and moorlands. Rare. The var. *β* in drier spots, and much more frequent than the type.

S. rigidum is hardly likely to be taken for any other species except the vars. *congestum* of *S. cymbifolium* and *confertum* of *S. papillosum*. From these it will at once be distinguished upon examination of the stem leaves, which in those species are larger, and want the border of narrow cells. The cucullate apex of the branch leaves is also very distinct from that in the present plant, when viewed under the microscope.

A curious feature of this species is that the perichaetial leaves are, in their areolation, much more like those of the branches than the stem leaves, whereas in almost all the other species they resemble the stem leaves in this structure.

C. SUBSECUNDA.

Cuticular cells of stem *without fibres or* (except rarely) *pores*. Stem leaves *bordered* with narrow cells. Branch leaves *usually subsecund*, more or less *oval*, at apex *rounded or widely truncate*, and toothed. Hyaline cells with *small* pores. Branches often curved.

4. Sphagnum subsecundum Nees. (Tab. I. F.).

Plants tall and rather slender, 4–12 inches high; often red-brown or orange, but not rose-coloured. Stems dark brown in the type, pale green in some of the varieties. *Cuticular cells in a single layer.* Stem leaves large or small, *oval-deltoid or oblong-lingulate*, at the summit rounded with the margin incurved and finely toothed or fringed at the apex. Cells all rather narrow, the marginal ones extremely so, forming a border narrow above, much wider towards the base; upper cells fibrose and porose, occasionally the lower ones also. Branches 2–4, the divergent ones spreading or deflexed, often flagelliform. Retort cells slightly recurved at apex. *Branch leaves more or less subsecund*, very variable, from broadly ovate to oblong-lanceolate, acuminate or obtusely pointed, 3–5 toothed at tip, very concave. Hyaline cells *narrow*, densely fibrose, *with many small pores, usually*

arranged in a regular row along each side of the cell. Chlorophyllose cells in section very narrowly elliptical, reaching both the front and back of leaf.

Var. β. *contortum* Schp. (*S. contortum* Schultz). Stem usually green, sometimes dark brown. Branches *stouter and more crowded* than in the type, *more or less curved and contorted;* the leaves *larger and broader,* usually more closely imbricated and less secund, so as to give the branches a smooth, terete appearance.

Var. γ. *turgidum* C.M. Resembling var. β, but branches *swollen,* terete, usually contorted. *acute;* branch leaves very broad, truncate at apex.

Var. δ. *obesum* Wils. Plants usually submerged, *robust,* dark coloured. Branches swollen, *obtuse,* the leaves more or less secund, broadly ovate or ovate-lanceolate; stem leaves resembling the branch leaves in form and areolation.

Var. ε. *viride* Boul. Plants soft, *more or less bright green,* in loose tufts; stem *pale,* green or yellowish. Branches usually *slender,* sometimes lightly arcuate; the leaves imbricated, sometimes squarrose (var. *squarrosulum* Grav.). Stem leaves large, often fibrose throughout, narrowly margined, sometimes distinctly and strongly auricled at the base with fibrose, inflated, hyaline cells (var. *auriculatum* Lindb.).

Hab. Wet heaths, pools, and ditches. Not common. The var. β more common and more widely distributed than the type. The var. γ in bogs and pools, frequent. The var. δ more rare, in deep pools, lakes, and ditches. The var. ε in more shady places, and sides of pools.

Sphagnum subsecundum among all our species produces the most widely differing varieties, if not so great a wealth of forms as *S. acutifolium.* It comprises plants of almost all shades of colour, and of almost every degree of robustness, some forms being as delicate as *S. tenellum,* while others rival the Cymbifolia group in size of leaves and thickness of branches. The typical form, much less frequent than the var. *contortum,* is best characterised by its dark stems, laxly set and slender branches, and its small stem leaves with few fibres.

The var. *turgidum* is in its extreme forms a marked plant, differing from Wilson's var. *obesum* (with which it has been erroneously confounded) by the cuspidate, terete branches, which are also usually much crowded.

I have followed Cardot in subordinating the var. *auriculatum* as only one of the forms of the var. *viride* Boul., which comprises a fairly well marked group of forms; whereas the auriculate base of the stem leaves is a character exceedingly variable and ill-defined, and one which may, moreover, be found equally in plants of the *contortum* and other groups.

The var. *simplicissimum* Milde mentioned by Braithwaite as having been found in Monmouth, and several similar plants from other localities, with simple stems, unbranched or nearly so, and with the stem leaves having the areolation usual in branch leaves, should be regarded as a form, or accidental state rather than a variety. The same state may not unfrequently be found mixed with the normal forms in other species as in *S. tenellum, S. rigidum,* and *S. molle.*

From its polymorphous nature *S. subsecundum* is liable to be confounded at first sight with several other species; the form and areolation of the branch

leaves will, however, usually serve to distinguish it from all but *S. laricinum*, while from that and from all other British species it is clearly marked off by the single layer of cuticular cells, when the stem is viewed in section.

S. subsecundum is split up by Warnstorf into eight (European) species, seven of which are found in Britain. They are characterised according to the differing number and arrangement of the pores on the back and front of the leaf, a system which appears to me highly artificial, and certainly corresponds to no natural grouping of forms by outward characters. *S. crassicladum* Warnst. would seem at first sight a well-marked and natural variety, comprising as it does a number of extremely robust handsome forms with large, terete branches, reaching at times as much as an inch-and-a quarter in length; but as it is made to include also forms totally different in appearance and falling naturally under others of the varieties, it cannot well be maintained here.

*** Sphagnum laricinum** Spruce (Tab. II. A.).

Differs from *S. subsecundum* only in the following points: Cuticular cells of stem in *two, sometimes three layers;* cells of branch leaves usually with fewer pores, and, according to Braithwaite, the *inner perichaetial bracts obtuse and emarginate*, instead of pointed as in that species. With regard to the minor characters sometimes given, such as the relative size of the stem leaves, and of the hyaline cells in the branch leaves, in the two plants, the statements of different authors are so directly at variance that it is clear no reliance can be placed upon them as distinguishing features.

Var. *β. platyphyllum* Lindb. Stems *short, the leaves distinctly auricled.* Branches short, rather obtuse, with imbricated leaves which are rounded ovate, pointed, very broad and concave.

Var. *γ. cyclophyllum* Lindb. (*S. cyclophyllum* Sull. & Lesq.) Stems *simple or nearly so.* Stem leaves *very large, orbicular,* cucullate.

HAB. Deep bogs. It appears to be a much rarer plant than *S. subsecundum*, for which, however, it may frequently have been mistaken. The var. *β* in peaty places, among short grass. Near Aber; Scotland. The var. *γ* very rare; Loch Katrine.

The character drawn from the perichaetial bracts may be of importance, should it prove to be constant. As to other points, there is a great discrepancy between authors as to the number of pores in the hyaline cells; thus Hobkirk (*Synopsis, Ed. 2, p. 40*) says, "Cells with annular fibres and many pores"; Russow and Warnstorf, "Pores on back of leaf isolated or numerous"; while in specimens of Gravet's which I have examined the pores at the back of the leaf are as numerous and regular as, if smaller and less conspicuous than, in *S. subsecundum*. In forms of this latter species, too, it is not unfrequently the case that the pores are less regular and less numerous than in the type. The colour in the type is generally yellowish, and the branches slender; some forms of *S. subsecundum*, however, are so closely identical that they can only be separated by the stem section, hence these characters are quite unreliable. There remains the character derived from the cuticular layers of the stem. In the species in which these cells occupy "from 2 to 3 layers" it is questionable whether if certain plants had them constantly in 2, and others constantly in 3 layers, this would, in the absence of other striking characters, be held sufficient to separate them as species. In point of fact, although in *S. squarrosum* these cells are in 2 layers, while in *S. teres* they are usually in

3 or 4, their separation as distinct species is not felt by authors (Braithwaite, Lindberg, &c.) to be thereby rendered necessary. And if so we may venture to ask where the radical difference lies when it is a question of 1 as against 2 (or sometimes 3) layers of cells. There seems too the less reason for insisting on this distinction, since Cardot affirms (*les Sphaignes d' Europe, 1886, p. 55*) that he has several times examined specimens of *S. laricinum* in which the second stratum of cells has been incompletely developed.

I have therefore followed the latter author in considering *S. laricinum* as a sub-species of *S. subsecundum*. This view is distinctly supported, moreover, by the fact that the variations of *S. laricinum* are almost exactly parallel to those of *S. subsecundum*,—the var. *teretiusculum* Lindb. agreeing exactly with the var. *contortum* of that species, the var. *platyphyllum* Lindb. with *S. subsecundum* var. *viride* Boul. (or var. *auriculatum* Lindb.). The var. *cyclophyllum* Lindb., by some authors, and subsequently by Lindberg himself considered a species, is said also by Braithwaite to correspond with the var. *obesum* Wils. of the former. There seems to be considerable difference of opinion about this variety, which, according to Lesquereux and James (*Mosses of North America, p. 22*) is allied to *S. subsecundum* rather than to *S. laricinum*, as it is described with "cortical cells in a single layer." It has very large roundish stem leaves, concave and cucullate, and the stems are frequently simple, or with very few, short, obtuse branches.

D. Squarrosa.

Moderate in size to robust. Cuticular cells of stem not fibrose. Stem leaves large with a *narrow border, not widened* at base. Branch leaves *frequently spreading abruptly in the upper half*, not undulate when dry; hyaline cells with *large* pores. Chlorophyllose cells nearer the *dorsal* surface.

5. Sphagnum teres Ångstr. (*S. squarrosum* var. *teres* Schp., Braithw. Sphagnaceae) (Tab. II. B.).

Slender; yellowish green or brownish; 4–8 inches high. Stem brownish red; cuticular cells usually in *3 layers, sometimes 4*, not porose. Stem leaves large, soft, *broadly oblong-lingulate and spathulate, rounded and somewhat fimbriate* at the top; cells without fibres or pores, short and very broad above, gradually becoming longer and narrower towards the base; *border very faint* or nearly obsolete, of narrow cells (but not so narrow as in most species), hardly reaching the summit of the leaf, and *of equal width throughout*. Branches 4–5 in a fascicle, the pendent ones closely appressed to stem; divergent branches terete, *slender, leaves imbricate, only very slightly recurved at apex*. broadly ovate, narrowed from the middle upwards to a rather acute point, 3–4 toothed at apex. Hyaline cells short and broad, with very large pores. Chlorophyllose cells narrow oval-rectangular in section, usually emerging on both sides of the leaf, but always more so on the dorsal than on the ventral face. Male branches clavate, the apex beyond the antheridia subsequently *elongating and flagelliform*. Dioicous.

Var. *β. squarrosulum* Warnst. (*S. squarrosulum* Lesq., *S. squarrosum* var. *squarrosulum* Schp. Syn.). Green above, whitish below; leaves *squarrose from the middle.*

Var. *γ. laxum* Dixon (*S. squarrosum* var. *laxum* Braithw.). Pale whitish green, usually ochraceous at base with ferruginous deposit, *soft, fragile;* 6–10 inches high. Stem leaves short, broad, *quadrate or quadrate-oval*, laxly areolate, often *strongly fimbriate* at the truncate apex. Branches very long, straight, deflexed, flagelliform; branch leaves divergent, *straight*, not squarrose (though here and there a branch may be found with the leaves strongly squarrose), ovate-lanceolate, acute.

HAB. Boggy places and springs in subalpine districts. Not common. The var. *β* usually in more shady places. The var. *γ* in ditches with iron deposit, Eskdale, Yorkshire; Flitwick, Bedfordshire.

*** Sphagnum squarrosum** Pers. (Tab. II. C.).

Larger in all its parts than *S. teres*, 8–18 inches high, rivalling *S. cymbifolium* in robustness. Cuticular cells of stem *in two layers*. Leaves of divergent branches *strongly squarrose from the middle* in the lower two-thirds of the branch, in the upper third imbricate and terete; their form as in *S. teres*, but *much larger*, the hyaline cells somewhat larger also. Male branches clavate, *rarely attenuated*. Monoicous or dioicous.

Var. *β. imbricatum* Schp. *Robust*. Branch leaves more or less *imbricated*.

HAB Bogs, Frequent.

Dr. Braithwaite in his splendid work on the Sphagnaceæ has clearly shown that *S. teres* cannot be separated as a species from *S. squarrosum*. I have followed Cardot, however, in subordinating the latter to the former, as a sub-species, instead of making *S. teres* a variety or sub-species of *S. squarrosum*, fully concurring in his reasons for so doing. Squarrose-leaved forms must be considered as diverging from the more normal, imbricated forms, and not *vice-versâ;* it is on precisely the same principle that the var. *squarrosulum* is looked upon as secondary to *S. cymbifolium*, the *contortum* forms of *S. subsecundum* to the type of that species and the var. *compactum* to *S. rigidum*. The fact that the *squarrosum* forms are more robust than those of *S. teres* is of course no argument against this view, as precisely the same is the case with the vars. *contortum* and *obesum* of *S. subsecundum*, with the var. *Torreyanum* of *S. cuspidatum* and with *S. riparium* as compared with *S. intermedium*.

S. teres var. *subsquarrosum* Warnst. is intermediate between the type and var. *squarrosulum*, only differing from the latter in having some leaves squarrose and some not; the three are connected by an almost unbroken series of forms; the same is the case with *S. squarrosum* and its var. *imbricatum*, which are united by all possible shades of transitional forms. The extreme state of the latter, with the leaves all imbricated and not squarrose, would appear to be very rare.

S. squarrosum can hardly be confused with any other species; the vars. *squarrosulum* of *S. cymbifolium* and *squarrosum* of *S. rigidum* might at first sight be sometimes taken for it, but the acute branch leaves of *S. squarrosum* will, on closer examination, make the distinction manifest at once. It is somewhat different with *S. teres*, forms of which might easily be taken for some of the Acutifolia section, but the form of the stem leaves, rounded at the summit and not distinctly larger above than at the base, and especially their very narrow margin, not widened at the base, will always reveal their

identity. The var. *laxum* was at first described by Braithwaite as *S. fimbriatum* var. *robustum* and is retained there by Warnstorf; the broad, strongly fimbriate stem leaves are indeed very suggestive of this species; I find, however, some of the stem leaves exactly typical of *S. teres*, while others in abnormal stems have both the form and areolation of *branch leaves* of *S. squarrosum*, but a little more obtuse; the leaves are also occasionally squarrose on the branches, and, moreover, the margin of narrow cells, though slightly broader at base, never passes into the very broad, dense column of linear cells so marked in *S. fimbriatum*.

E. Acutifolia.

Variable in size, branches usually *slender*. Cuticular cells of stem not fibrose, *often porose*. Stem leaves *bordered*. Branch leaves *ovate-lanceolate or lanceolate* (rarely shortly ovate and obtuse), *acute or narrowly acuminate, narrowly truncate* and toothed at apex. Chlorophyllose cells nearer the *ventral* surface.

6. Sphagnum molle Sull. (Tab. II. D.).

Usually pale or yellowish green, in *soft* tufts. Height 3–6 inches. Stems pale green. Stem leaves *large*, usually *broadly lingulate-spathulate* or *obovate-spathulate, narrowed* to the obtuse apex, which is 3–7 toothed; *bordered with a very few rows of linear cells;* the median cells variously fibrose and porose in the upper part of the leaf only, or almost to the base. Leaves of divergent branches *ovate-oblong or ovate-acuminate*, concave, convolute above, *faintly toothed at margin* in the upper part; apex more or less truncate and 5–6 toothed. Hyaline cells with a few large pores. Chlorophyllose cells oval-triangular in section, *ventral*, but sometimes reaching the dorsal surface.

Var. *β. tenerum* Braithw. In *dense, short*, whitish tufts. Branches more *closely set*, short, with acuminate leaves.

Hab. By moorland streams, not common. The var. *β* in drier places, rare.

The British plants have been for the most part referred to the var. *Müllèri* (*S. Müllèri* Schp.), distinguished by the stem leaves fibrose and porose almost to the base; but this has been shown to be an altogether uncertain character, and Warnstorf, no doubt rightly, fails to recognise the variety.

S. molle is sometimes very difficult to distinguish from other species, and especially from *S. acutifolium*, more particularly the var. *subnitens;* in these cases it is difficult to name any one character by which they may be definitely separated, though the toothed margin of the branch leaves in the present species may perhaps afford a useful test. The absence of red in our plant is usually enough to determine it, together with the soft texture, the extremely *narrow* margin of the stem leaves, and their greater size and width; but there are forms of *S. acutifolium* with fibrose and narrowly margined leaves; in these cases the colour and texture, the less acute and more abruptly truncate, denticulate branch leaves in *S. molle*, taken together, will form a combination of characters probably not to be found in any of the forms of that species. The few and scattered pores in the branch leaves will serve to separate *S. molle* from *S. subsecundum*. The var. *tenerum* may easily be confounded with the compact form of *S. acutifolium*, but under the microscope the resemblance will probably disappear.

The stem leaves in *S. molle* are usually, but not quite always, broader in the middle than at the base. The margin is sometimes reduced so as to be very indistinct, but is at times very clear, and occasionally a little widened out below.

7. Sphagnum acutifolium Ehrh. (Tab. II. E.).

Tufts, soft, pink, pale green, or whitish, but *always with some admixture of red* (in some cases confined to the male branches) 3–12 inches high. Stem generally reddish, sometimes green, cuticular cells with or usually without pores. Stem leaves very variable, usually small, oval-triangular, gradually or abruptly narrowed to an obtuse point, with about 5 teeth; sometimes larger, lingulate or broadly oblong with a more or less rounded top and somewhat fringed, but *always wider at the base than at the top*. Upper cells usually without fibres and pores, sometimes slightly fibrose and more rarely porose; frequently divided into two or more compartments by thin oblique partition walls. *Border*, composed of linear cells, *very wide at the base*, gradually narrowing upwards, *but still remaining of some width*, and reaching to apex. Divergent branches soft, slender. Leaves varying from almost exactly oval to narrowly ovate-lanceolate, truncate and toothed at apex, where the margin is incurved. Hyaline cells large, with large pores. Chlorophyllose cells oval-triangular in section, on the ventral surface of the leaf, scarcely reaching the dorsal face. *Male branches always red.* Monoicous or dioicous.

a. S. acutifolium Russ. & Warnst. The plant considered as the type of *S. acutifolium* by Warnstorf is extremely variable in size and habit, when dry without the metallic lustre characteristic of the vars. β and ζ. Stem leaves *triangular* or triangular-lingulate, not lingulate as in vars. γ, δ, ϵ, η. Outer cells of stem *without pores*. Wood cylinder pale or red, never brown. Branch leaves almost always *closely imbricate* when dry, neither secund, squarrose, nor distinctly in five rows.

Var. β. *subnitens* Dixon (*S. subnitens* Russ. & Warnst.). Plants *soft*, variable in colour, usually *robust*. Outer layer of cells of stem with or without pores. Wood cylinder green to red, never brown. Branch leaves usually large, when dry mostly imbricated, with a *bright metallic lustre or iridescence*. Stem leaves large, frequently undulate at margin, *triangular* (quickly narrowed from a wider base), *often prolonged at apex into a broad truncated point.*

Var. γ. *rubellum* Russ. (*S. rubellum* Wils., Schp. Syn.). Plants generally soft, *slender and delicate*, pale green or rosy red. Outer stem larger, mostly without pores. Wood cylinder pale or reddish, never brown. Stem leaves lingulate (not much widened at base), often fibrose above. Branch leaves *short*,

small, *shortly pointed, often subsecund when dry*. Pores of dorsal surface towards apex *large*, strongly ringed.

Var. δ. *gracile* Russ. (*S. Warnstorfii* Russ.). Plants slender and delicate, but *not soft or flaccid*, variously coloured, usually mixed with red. Outer stem-layer mostly without pores. Wood cylinder usually deep red, never brown. Stem leaves lingulate. Branch leaves when dry *curved, spreading at apex*, frequently in five rows. Leaves of the *lower* half of the branches with *very small, strongly ringed* pores on the dorsal face towards apex.

Var. ε. *fuscum* Schp. (*S. fuscum* Klingg.). Tufts usually forming dense cushions, *brownish green or snuff-coloured*. Outer stem-layer mostly without pores ; wood cylinder always *reddish brown*. Stem leaves lingulate. Branch leaves when dry *imbricate*, small, with a shortly truncate point. Pores of dorsal face near apex small, strongly ringed.

Var. ζ. *quinquefarium* Lindb. (*S. quinquefarium* Warnst.). Variable in size and colour, often bright pale green, with or without a rosy tinge. Wood cylinder of stem *pale or yellow, never red ;* outer cells of stem *porose* (the pores often very indistinct). Stem leaves *triangular*. Branch leaves when dry *with a slightly metallic lustre* (especially in the capitulum), *5-ranked*, so that the branches are 5-angled, not secund ; imbricate or spreading, small. Pores of the dorsal surface near apex *large*.

Hab. Very abundant throughout Britain. The type seems to be less common than most of the vars. Var. *subnitens* the commonest member of the group. Vars. *rubellum* and *fuscum* principally on moorlands, common. Var. *gracile* in low lying bogs or swamps in woods, rarely on moorlands. Var. *quinquefarium* chiefly in mountainous districts, rare in the lowlands ; frequent and often very fine and well marked on wet rocks in mountain woods.

S. acutifolium is the most variable of all the species. The varieties are so endless, and so complex in character, as almost to defy classification. Almost every writer on the genus has his own system and his own nomenclature ; and since different authors base their systems on such different characters as the form of the stem leaves, the form and arrangement of the branch leaves, the arrangement of the pores in the hyaline cells, etc., any attempt to collate these various forms is frustrated by the overlapping of the groups. When it is stated that Russow and Warnstorf alone describe nearly 60 European varieties entirely based on colour, Cardot above 30, only a part of these corresponding to the former ones, and so on with other authors, some idea will be formed of the great number of varieties and the difficulty of treating them. I have adopted Warnstorf's arrangement of the forms of this difficult species, as it appears on the whole to correspond to a certain natural grouping according to habit. Some forms remain difficult to place, and some, referable on structural grounds to one or other of the varieties are quite wanting in the habit generally characteristic of that variety ; but the system has yet to be found which will eliminate these difficulties. The general characteristics of the varieties may be noted as follows. Var. *fuscum* differs from all the others in the brown or reddish-brown wood cylinder of the stem. It usually forms dense deep cushions of a brown or snuff colour, a very unusual hue in the Sphagna. When, as is rarely the case, it is of a greenish colour, it resembles vars. *rubellum* and *gracile*. Var. *quinquefarium* is distinct in the 5-rowed leaves,

the pale wood cylinder, and the metallic lustre when dry (not always very marked). Vars. *rubellum* and *gracile* are much alike, but the texture is more rigid in the latter, the branch leaves are more spreading when dry, and the pores of the branch leaves distinct. Var. *subnitens* is one of the best marked varieties, of more robust build than most, with larger branch leaves and therefore stouter branches ; and the metallic lustre, when dry, is very marked. It sometimes closely resembles *S. molle*, but has the border of the stem leaves much widened below, and the margin of the branch leaves not toothed.

The red hue prevalent in *S. acutifolium* is usually sufficient to distinguish it from any other species ; where this is absent and confusion is likely to arise with any other, I have endeavoured to point out the distinguishing characters under the description of that plant.

* **Sphagnum Girgensohnii** Russ. (*S. strictum* Lindb., Braithw. Sphagnaceae) (Tab. III. A.).

Closely resembling *S. fimbriatum* in most characters, including the porose cells of the stem cuticle, it differs in the somewhat *more robust* habit, frequently rigid, especially when dry, with the branches slightly shorter and stouter ; and especially in the stem leaves, which are broadly oblong, *not wider above than at the base*, and *only fimbriate over about* $\frac{1}{2}$ to $\frac{2}{3}$ *the width of the leaf at apex*, with the border of narrow cells reaching nearly to the top ; hyaline cells with few or no oblique partitions. Male branches clavate, *yellowish brown.*

Var. *β. robustum* Russ. (*S. Russowii* Warnst.). Usually tall and *robust ;* very variable in colour. Wood cylinder pale or red. Outer stem-layer *with a pore in nearly every cell.* Male branches *red.*

HAB. Frequent in mountainous districts, elsewhere rare. The var. *β* in similar localities, often mixed with the type.

I have followed Cardot in ranking *S. Girgensohnii* as a sub-species of *S. acutifolium.* I have placed the var. *robustum* under it, instead of, as formerly, under *S. acutifolium.* The red colour of the male branches, and occasionally of the stem, are the principal or sole reason for its being subordinated to the latter species ; but on the whole the character of the stem leaves, the habit, and especially the nearly constant presence of large pores in the surface cells of the stem, appear to give it a closer affinity to *S. Girgensohnii ;* and the last mentioned character will serve to separate it at once from forms of *S. acutifolium.*

The stem-leaves, narrowed above and only toothed or fimbriate over a small portion in the var. *robustum*, lingulate and fimbriate over the whole of the rounded apex in *S. Girgensohnii*, have been supposed to separate the two distinctly ; but Russow describes the stem leaves of *S. Girgensohnii* var. *coryphaeum* as "narrowed above, with the apex slightly truncate and toothed." The presence or absence of large pores in the superficial cells of the stem therefore remains as the sole constant character distinguishing the two ; and it seems perfectly clear that *S. Girgensohnii* is an intermediate stage between *S. acutifolium* and *S. fimbriatum*, but so closely linked with the former by the var. *robustum* that it must take its rank with it as a sub-species. In the description I have compared it with *S. fimbriatum*, because from the colour it is more likely to be confounded with that species, to which indeed, on the opposite side, it is very closely related.

From all other species the broad border of the stem leaves taken in conjunction with the numerous large pores of the branch leaves will at once distinguish it.

8. Sphagnum fimbriatum Wils. (Tab. III. B.).

Loosely tufted; pale green or whitish brown; tall and *slender*, 6–14 inches high. Stem pale, cuticular cells in 2 or 3 layers, *porose*. Stem leaves *very broadly obovate-spathulate, almost as broad as long, wider above, rounded and slightly flattened at summit*, the whole of which, together with the upper portion of the sides, is *fringed* as with delicate cilia by the thread-like partitions of the eroded cells. *Areolation very wide at summit*, narrowing downwards, without fibres or pores, but with *partitions across many of the cells. Cells at basal angles extremely narrow*, forming a border or column on each side extending to about $\frac{1}{3}$ the width of the leaf, the median basal cells between the borders being much wider. Branches 3–4 together, *very long and slender*, two arcuate and decurved, the others pendent and appressed to stem. Branch leaves closely imbricated, lower ovate-lanceolate, upper lanceolate, gradually narrowed from below the middle to the acute apex, which is slightly truncated and toothed; margin incurved above. Hyaline cells of medium size, *with many large pores*. Chlorophyllose cells in section compressed, elliptical or slightly wedge-shaped, emergent on the upper surface of the leaf, usually slightly enclosed by the hyaline on the back. Perichaetial bracts large, obtuse. Male branches yellowish.

Hab. Bogs and marshes, sides of streams, etc., mostly in lowland districts, frequent; often abundantly fertile.

Sphagnum fimbriatum is one of the least variable members of the genus; in colour it is always of a pale green or yellowish brown, without tinge of red; this will serve to distinguish it from all forms of *S. acutifolium* except the very few which are entirely green, and from these the stem leaves essentially separate it, as indeed they do from all other species, the only approach to it in this respect being in the case of *S. Girgensohnii*, *S. Lindbergii*, and some forms of *S. teres*; from the last the broadly bordered stem leaves will clearly distinguish it, as will the rounded summit of the stem leaves and the numerous large pores in the branch leaves from *S. Lindbergii*. The characters by which it may be known from *S. Girgensohnii* are pointed out under that plant.

The leaves of *S. fimbriatum* are occasionally distinctly squarrose, in which case the resemblance to some forms of *S. teres* is very striking; they are, however, decidedly narrower than the leaves of that species.

F. Cuspidata.

Cuticular cells of stem not fibrose. Stem-leaves bordered, the border *often much widened* at base. Branch leaves usually *narrowly acuminate;* when dry *somewhat flattened* (not very concave), *frequently undulate, or recurved at tip*. Chlorophyllose cells on the *outer* surface. Plants frequently aquatic.

9. Sphagnum Lindbergii Schp. (Tab. III. C.).

Robust, 6–12 inches high. Variously coloured, usually yellowish green, with a more or less deep tinge of reddish brown. Stem dark brown; cuticular cells *without pores*. Stem leaves

reflexed, *shortly and broadly oblong or almost square*, slightly wider at the top and *truncate, fimbriated across the whole width of the leaf, but not down the sides, cells very broad and lax above*, gradually narrowing towards the base, especially at margin, where they form a *wide border* which rapidly becomes narrower as it ascends the leaf. A few fibres and pores only in the small auricular cells at base. Branches 4–5 in a fascicle, the divergent ones spreading, the pendent closely appressed to the stem. Branch leaves more or less regularly arranged in 5 rows, slightly undulate when dry (in some forms distinctly so, in others not at all), firm, glossy, broadly or narrowly ovate-lanceolate, more or less acuminate, truncate and toothed at apex, with involute margin ; border of narrow cells rather distinct, widest at base. Hyaline cells with pores of a medium size, usually few in number, but sometimes more numerous. Chlorophyllose cells in section oval-triangular, emerging on the *dorsal face*, enclosed by the hyaline on the ventral surface. Antheridia on pendent branches.

HAB. Deep bogs in the north, very rare ; Ross ; Shetland.

A very fine plant, resembling *S. intermedium*, but differing entirely in the form of the stem leaves, and also in the branch leaves not flexuose nor recurved when dry. I have received a variety of forms gathered in Labrador from the Rev. A. C. Waghorne, some of them, notably vars. *immersum* and *fuscescens* Warnst., very robust, dark brown or purplish black, with very large elongated leaves, which are secund at the apex of the branches, and sometimes distinctly undulate when dry.

10. Sphagnum intermedium Hoffm. (*S. recurvum* P. Beauv., Schp. Syn.) (Tab. III. E.).

In loose masses, pale green, yellow or whitish, 6–12 inches high or more. Stem very pale, greenish white ; cuticular cells usually in 2 layers, *hardly distinct from the outer layers of the central axis*, non-porose. Stem leaves *small*, reflexed, *deltoid or ovate-triangular*, narrowed to an obtuse point, which is toothed or slightly eroded ; cells mostly *without fibres or pores*, border very broad at base, narrowing upwards but reaching summit, and still several cells in width in the upper part of the leaf. *Stem concealed by the pendent branches*, which are closely appressed. Leaves of divergent branches broadly lanceolate ; closely imbricated, erecto-patent and straight when moist, *when dry undulate at margins, flexuose and recurved at apex*, so as to give the branches a soft and feathery appearance. Margin involute at the tip, apex toothed, truncate. Hyaline cells with a *very few small pores*. Chlorophyllose cells oval-triangular in section, on the *dorsal* surface (cf. Tab. LXI. B. 2 x'). Spores usually *yellow*.

Var. *β. pulchrum* Lindb. *Robust*, golden yellow. Stem-leaves slightly fibrose above, *contracted into a minute, recurved apiculus*. Branches thick, short, spreading or ascending, dense-leaved.

Var. γ. *parvifolium* Warnst. *Very small and slender.* Stem and branch leaves *very small,* branch leaves scarcely undulate when dry.

HAB. Bogs and pools, frequent. The var. β in bogs mostly in the north. The var. γ rare.

Sphagnum intermedium in the humid state is difficult to distinguish from *S. Girgensohnii,* and some green forms of *S. acutifolium* and *S. subsecundum.* The broadly-bordered, non-fibrose stem leaves of the present species will distinguish it from the last, which has also the pores of the branch leaves numerous ; while the large pores in the branch leaves of the two former will serve to distinguish them at the outset. When dry the soft, flexuose, and recurved leaves, flattened above and not involute or tubular, at once separate it from all other species. It may be remarked that the *squarrose* leaves of *S. squarrosum* are more rigid, and, as it were, suddenly *bent* back at an angle from the rest of the leaf, while the *recurved* leaves of the present species turn back in a gradual *curve.*

The differences between the present plant and *S. cuspidatum* are dealt with under that species.

The var. *pulchrum* is a very robust and handsome variety. The var. *parvifolium* is very small, and superficially resembles some forms of *S. acutifolium* very closely.

* **Sphagnum riparium** Ångstr. (*S. intermedium* var. *riparium* Lindb., Handb. Ed. I. ; *S. spectabile* Schp. Syn.) (Tab. III. D.).

Nearly allied to *S. intermedium,* but *much more robust.* Cuticular cells absent, or sometimes present and clearly differentiated. Stem leaves *large,* triangular or triangular-lingulate, *fimbriate and deeply cleft at the rounded apex.* Branch leaves large, *long, and finely acuminate,* margin incurved at apex ; upper part of leaves *frequently composed entirely of chlorophyllose cells.*

HAB. Deep pools, usually submerged. Extremely rare ; England.

The characters drawn from the stem leaves, as pointed out by Warnstorf, appear to justify its being raised to the rank of a sub-species, a position to which it also lays claim strongly by its size and beauty. The increase in the chlorophyllose cells in the leaf apex at the expense of the hyaline is found similarly in other aquatic Sphagna, and though a striking feature, is not of itself an important, nor indeed is it a constant character. The apical hyaline cells themselves are frequently altered in form, being very narrow and without fibres.

11. Sphagnum cuspidatum Ehrh. (Tab. III. F.):

Green or yellowish white ; usually more or less aquatic and submerged, 6–18 inches high or more. Stem pale green or pale brown, cuticular cells in 2–3 layers, *distinct,* not porose. Stem leaves longer than in the last species, often pointed, *fibrose in the upper part* and often to the base ; margin as in that species, but of somewhat *longer and narrower cells.* Pendent branches not

so closely appressed, and *not concealing the stem*. Divergent branches cuspidate at the apex, with the upper leaves often falcato-secund; the leaves less closely imbricated than in *S. intermedium*, longer and narrower, with a broader margin, the cells usually with rather more numerous pores; *undulated at margin*, but less flexuose when dry and hardly recurved at apex except in the short branches of the capitulum. Chlorophyllose cells wider, somewhat four-sided, generally *free on both surfaces of the leaf*. Perichaetial bracts less pointed. Spores *brown*. In other respects like *S. intermedium*.

Var. β. *falcatum* Russ. Branches more or less *arcuate and falcate;* branch leaves narrowly lanceolate, *the terminal ones falcate*.

Var. γ. *plumosum* Nees and Hornsch. *Submerged*, flaccid, elongated. Branches *uniform, divergent*, plumose, with *very long, lanceolate-subulate, spreading leaves*.

Var. δ. *Torreyanum* Braithw. (*S. Torreyanum* Sull.). Submerged, *very robust*, more rigid; dirty brown. Stem leaves large, *non-fibrose*. *Branch leaves very large*, elongate, lanceolate-subulate, tubulose and toothed at apex. Chlorophyllose cells in lower half of leaf *completely enclosed on the inner surface*, and not nearly reaching that surface.

Var. ε. *brevifolium* Lindb. (*S. balticum* Russ.). Stems firm, 5–6 inches high, pale; *stem leaves short, ovate*, obtuse. Branches in closely set fascicles, short, ascending and divergent, arcuato-decurved from the middle, attenuated; the leaves subsecund when dry, scarcely undulate, *short, ovate*, somewhat oblique and unequal sided. Chlorophyllose cells in lower half of leaf *completely enclosed* on the inner surface, *but nearly reaching that surface*.

HAB. Pools and wet bogs, frequent. The vars. β, γ, δ in standing water. The var. *Torreyanum*, Whitchurch and Whixall Moor, Shropshire: Merioneth. The var. *brevifolium* on elevated moors, rare; England; Scotland.

S. cuspidatum is closely allied to *S. intermedium*, the characters by which they are separated being almost all comparative. Authors differ very much in their description of the state of the leaves when dry, some saying they are not at all crisped, while others describe them as more or less flexuose. The fact is they vary considerably, some forms having the leaves straight when dry, and only slightly undulated at margin, while in others they are recurved and flexuose, almost exactly as in *S. intermedium*. This is the case with a form sent me by Mr. Boswell, from Whixall, Shropshire. In the short branches of the capitulum the leaves seem indeed usually to be recurved at apex, exactly as in *S. intermedium*. The stem leaves, too, are not always fibrose, and forms are found, according to Cardot, with the cuticular cells indistinct.

The var. *plumosum* is a very beautiful form when growing, but it is almost impossible to preserve its delicate, feathery appearance when dried except by careful floating out on paper. The marginal cells are not unfrequently denticulate in the submerged forms (var. *serrulatum* Schlieph.). The var. *Torreyanum* is distinguished by the length of the leaves and especially by the

position of the chlorophyllose cells, but other robust forms sometimes so nearly resemble it as to be separated only with great difficulty. Other allied or varietal forms not yet detected in Britain are described in the detailed works already referred to.

The long flat leaves of *S. cuspidatum*, undulated at margin, are sufficient to distinguish it from all others of the Acutifolia and Cuspidata sections, except *S. intermedium*, which differs in the characters given above.

12. Sphagnum tenellum Pers. (*S. molluscum* Bruch, Schp. Syn). (Tab. III. G.).

Plants rather densely tufted, 2–6 inches high, very *slender* and fragile, greenish yellow. Stem pale, cuticular cells in two layers. Stem leaves rather large for the size of the plant, *oval-oblong; rounded above with the margin incurved*, and with a few small teeth at the apex; upper median cells fibrose with a few small pores, the basal ones much narrower, and passing insensibly into the *very broad border* of narrow marginal ones, which, however, becomes narrower as it reaches higher up the leaf, until at the apex it consists only of two or three rows of narrow linear cells. Branches short, *the retort cells much recurved at apex;* leaves small, somewhat loosely set, often subsecund, *broad and short, widely ovate and ovate-oblong*, obtusely pointed, concave, margin incurved above, apex 3–5 toothed; bordered with a somewhat broad margin of linear cells, in 3–4 rows. Hyaline cells small, but broad, with numerous rather small pores on the ventral surface. Chlorophyllose cells triangular in section, on the *dorsal* face of the leaf. Capsule thin-walled.

HAB. Bogs. Frequent.

Sphagnum tenellum is the smallest and most delicate of our species, and is hardly likely to be confounded with any other, the broadly oval, short-pointed, boat-shaped leaves serving to distinguish it from slender forms of the Acutifolia group; while the strongly recurved apex of the retort cells, and the much shorter and broader hyaline cells of the branch leaves will serve to separate it from small varieties of *S. subsecundum* and from *S. molle* var. *tenerum*.

Andrews has conclusively shown (*Bryologist, xxii. 45*) that the name *tenellum* has priority over that of *molluscum*, the name adopted in most recent works.

Braithwaite records var. *longifolium* Lindb., but it does not appear to be a strongly marked form.

The position of the pores on the *ventral* surface of the branch leaves instead of on the dorsal surface as usual is, I think, to be explained by the dorsal position of the chlorophyllose cells. The object of the pores being to facilitate the passage of water through the plant, it is natural that they should be most numerous at the chief point of junction of adjacent hyaline cells; this is usually on the dorsal surface of the leaf, but in this species it is on the ventral surface, owing to the dorsal position of the chlorophyllose cells. This is borne out by the fact that the only two other British species in which the pores preponderate on the ventral face are likewise the only two in which there is the same (dorsal) position of the chlorophyllose cells, with the exception of *S. Lindbergii*; here, however, the pores are very few in number, and although certainly more numerous on the back of the leaf, are to be found in the front also.

SUB-CLASS II. ANDREAEALES.

Spores and Columella developed from the Endothecium, the Columella not penetrating the spore-bearing layer. Spore-sac not separated from the wall of the capsule by any air-cavity. Capsule opening by longitudinal slits.

Order II. ANDREAEACEAE.

Mosses with something the habit of the lesser species of Grimmia, in small compact cushions or more rarely in laxer tufts; growing on rocks; of a dark reddish or purplish colour; stems slender, rooting only at the base, very fragile when dry, dichotomous, with fasciculate branches. Leaves usually crowded, small, erecto-patent or falcato-secund, of rather thick texture, from bright orange to deep purplish red or almost black, usually more or less papillose; cells small, incrassate, rectangular and often sinuose at base, rounded or angular above.

Flowers terminal; fruit, as in Sphagnum, enclosed until ripe in the perichaetium, then exserted on a pseudopodium by the elongation of the vaginula; calyptra membranaceous, irregularly torn at the base. Capsule oval, without lid, splitting perpendicularly into 4, rarely 6–8 valves, united at top and bottom. Columella persistent. Spores smooth or lightly papillose.

The leaves when viewed by transmitted light are usually of a bright orange or reddish brown, but when seen by reflected light, as in the field, and especially when dry, they appear of a much duller and darker hue, not unfrequently appearing almost black. It is only when quite young and half-developed that they show any trace of chlorophyll. In leaf-structure there is a certain resemblance to the Grimmiaceae, and the Andreaeaceae are by Lindberg placed next to that order.

There is, as in the Sphagnaceae, very little variation in the fruit; the specific characters have therefore to be drawn almost entirely from the perichaetia and the leaves; it is probably on this account that there has been a tendency to found species on somewhat slight and inadequate characters.

The species of Andreaea inhabit siliceous and quartzose (not calcareous) rocks, in alpine and sub-alpine regions of both hemispheres, chiefly in the higher latitudes. In Europe it is in Scandinavia that they are found in greatest abundance and variety, and several endemic species occur there.

It will be found a material aid in the determination of these plants to soak the leaves, or heat them for a minute or two over a spirit lamp, in strong caustic soda or potash; this renders them more transparent and elucidates the structure of the cells and nerve. Care must be taken, in examining the leaf margin, to

avoid taking for a normal condition the eroded appearance of the cells which, in older leaves especially, is often found to obtain, from the wearing away of part of the cell-wall; this often gives a false appearance of papillosity, crenulation, or dentation, or it may suggest a more or less hyaline border to the leaf, and in the nerved species may easily lead to an erroneous conclusion that the nerve is excurrent.

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2. **ANDREAEA** Ehrh.

The only genus.

DERIV.—After Andreä, an apothecary of Hanover.

1 { Ls. nerveless 2
  { Ls. singly nerved 3

2 { Ls. ovate-lanceolate, papillose, obtuse or more or less acute... *1. petrophila*
  { Ls. obovate-spathulate, shortly acuminate, smooth..... *2. alpina*

3 { Ls. all similar, papillose, nerve narrow..... *4. nivalis*
  { Stem ls. smaller than perich. ls., smooth or nearly so..... 4

4 { Nerve thick, occupying nearly all width of subula..... *3*. crassinervia*
  { Nerve less defined, occupying only middle third of subula..... *3. Rothii*

A. EU-ANDREAEA.

Perichaetial bracts different from the leaves, erect and convolute, nerveless, or almost so. Capsule 4-valved.

1. Andreaea petrophila Ehrh. (Tab. IV. A.).

Tufts *small*, olivaceous or dark brown. Stems slender, ½–1 inch high, simple, or several times forked, usually erect. Leaves crowded, imbricated or more or less turned to one side, *small, ovate or oblong-lanceolate*, usually patent from an erect base, often falcato-secund, narrowed at apex but usually obtuse, sometimes with a minute apiculus formed of a single cell, sometimes more acute, the tip often oblique; margins incurved, entire; *nerveless, strongly papillose at back*, especially in the upper part. Areolation narrowly rectangular at base, sinuose with very incrassate walls, gradually shorter upwards, in the upper half of the leaf rounded-hexagonal, almost always more or less angular, arranged in longitudinal rows. Autoicous; male flower on the apex of a separate branch; perichaetium large, inner bracts convolute, *broadly oblong*, obtusely pointed; outer bracts strongly papillose, the inner almost smooth, but usually slightly papillose towards the apex.

Var. *β. acuminata* B. & S. More robust. Leaves spreading, *acuminate*, with longer papillae.

Var. *γ. gracilis* B. & S. Stems *very slender*, branched, reddish; leaves more distant, *broadly oblong-lanceolate*, suberect; perichaetium narrow, cylindric.

Var. δ. *alpestris* Thed. (*A. alpestris* B. & S., Schp. Syn.). Densely cushioned; black-brown, shiny. Stems very slender, much branched. Leaves small, *crowded, closely imbricated when dry*, obtuse, *cells less incrassate, less distinctly papillose.*

Var. ε. *sparsifolia* Lindb. (*A. sparsifolia* Zett., Schp. Syn.). In small lax tufts, stems very slender and *fragile*, flexuose, with few branches. Leaves small, *distant, spreading*, the uppermost secund, lanceolate, *gradually acuminate, acute, more shortly papillose.*

HAB. Mountain rocks; common. The vars. β, δ, ε, on the higher mountains; var. *alpestris* rare. Var. *sparsifolia*, Ben More, Perthshire.

A very variable species within certain limits, principally in the form and direction of the leaves; these are often more or less secund; when markedly so it is the var. *homomalla* Thed. The vars. *flaccida* and *sylvicola* Schp. agree with var. *acuminata* in having the leaves gradually tapering to the summit, but do not appear to be very marked forms. The var. *alpestris* has been frequently considered a species, but the differences are too slight to render this admissible; the leaves vary in size, their close imbrication when dry and the less papillose areolation constitute almost the only points of distinction. The var. *sparsifolia* is a more striking form, but its structural differences are very insignificant.

A. obovata Thed., a nearly allied species hitherto only found in Norway, differs in the leaves, broader below, more acuminate, not papillose; in fact much resembling those of *A. alpina*, but smaller, and more longly acuminate, with the basal margin quite entire, and with larger cells.

2. Andreaea alpina Smith (*Jungermannia alpina* L.) (Tab. IV. B.).

A larger plant than the last species, less slender and fragile, 1–3 inches high, in larger, looser tufts, fastigiate-branched, of a rich purplish red. Leaves *larger, broader, obovate, spathulate*, acuminate or obtusely pointed, panduriform by contraction just below the middle, erecto-patent when moist, when dry more closely imbricated, smooth, glossy, *nerveless. Margin distinctly denticulate above the base*, entire in the upper part of the leaf. Cells, *smooth*, oval or rounded-hexagonal at apex, in parallel rows, gradually becoming more elongate and sinuosely angular downwards, at base extremely narrow and sinuose, with very incrassate walls. Autoicous. Perichaetial bracts resembling the comal leaves, but larger, broader, convolute, more shortly acuminate.

Var. β. *compacta* Hook. Short, *densely cushioned*, dark purplish black. Branches straight, equal; leaves closely imbricated.

Var. γ. *flavicans* Hook. *Stems elongated*, filiform, *the leaves more distant*, laxly imbricated, *yellowish.*

HAB. Mountain rocks, frequent. The var. β on the higher mountains of Scotland and Wales; the var. γ on Ben Nevis.

This fine and distinct species, though distributed all over Britain and not rare on our mountains, is almost unknown on the Continent, being only recorded from the Faeroes and a few localities in Norway. It is in its usual growth a much taller and less rigid plant than any of the forms of *A. petrophila*, and is indeed more likely to be mistaken for a species of Hepatic, such as *Nardia emarginata*, with which it may occasionally be found associated, and to which, indeed, it bears considerable superficial resemblance, than for any other species of moss. The var. *flavicans* has some resemblance to *A. Hartmani*, another of the Scandinavian species, which, however, may be known by its more obtuse, entire leaves, and larger areolation.

3. Andreaea Rothii Web. & Mohr (*A. rupestris* Schp. Syn.) (Tab. IV. C.).

In *small, dense*, blackish tufts, laxly coherent when moist. Stems erect or decumbent, slender, very fragile when dry, less than one inch high. Leaves crowded, erecto-patent or more usually turned to one side, and generally more or less falcate; from an oblong, oval, or slightly obovate base, either *gradually or suddenly narrowed to a long lanceolate or narrowly linear limb*, tapering to an obtuse point. *Nerve strong*, $\frac{1}{5}$–$\frac{1}{7}$ width of leaf at base, reaching to apex (excurrent in sub-species *crassinervia*), occupying the greater part of the limb in the upper part. Margin plane, entire or faintly dentate at apex. Cells rounded, hexagonal and punctiform above with very incrassate walls, *smooth*, not much altered below except at mid-base, where a few rows of cells on each side of the nerve are narrowly rectangular. Autoicous. Inner perichaetial leaves convolute, sheathing, nerveless or thinly nerved, broadly ovate, gradually or somewhat abruptly acuminate, narrower and more tapering than in the two previous species.

Type. Leaves erecto-patent or secund, *gradually narrowed* from base upwards, *entire*, lamina usually of 3–5 cells width in upper part of limb.

Var. β. *grimsulana* Hook. & Wils. (*A. Rothii* var. *frigida* Lindb., Braithw. Br. M. Fl.). More robust, taller, usually of a more reddish tinge. Leaves *broader, gradually narrowed from* the base, *more solid*. Nerve stouter, especially at base.

Var. γ. *hamata* Lindb. Intermediate between the type and var. *falcata*. Leaves *falcato-secund, gradually narrowed* from base upwards, lamina *narrow*, but continuous above, *entire*.

Var. δ. *falcata* Lindb. (*A. falcata* B. & S., Schp. Syn.). Leaves *falcato-secund, abruptly narrowed* above the broader, obovate base to a long, linear limb, the lamina continued to apex, *very narrow* and indistinct in the upper part, usually of about 2–3 series of cells; margin frequently *distinctly notched* towards the apex.

Hab. Mountain rocks, frequent. The var. β, wet rocks on high mountains, very rare. The var. δ as frequent as the type.

The characters which separate the vars. *hamata* and *falcata* are very ill-defined; the sudden narrowing of the leaf above the base is by no means constant even in all the leaves from a single stem; the relative width of the lamina in the upper part varies very much also (it must be remembered that the young comal leaves do not afford any safe guidance in this respect); and a faint notching may occasionally be seen in the upper leaves even of the type. The form of leaf typical of the var. *falcata* is also associated occasionally with a spreading (not falcato-secund) position of the leaves.

In the forms with a narrow base to the leaves the lower cells are more distinctly rectangular; in the *falcata* forms they are usually more rounded and very little different from the upper cells except those very near the nerve. In examining the upper cells of this species it should be noted that on the surface of the leaf they are angular and more or less regularly hexagonal, but in the interior of the cell the wall is thickened in such a way that the cell cavity is rounded, or punctiform, hence the areolation takes a different aspect according as the microscope is focussed on the surface of the leaf or slightly lower down.

The lower part of the stem and innovations is not unfrequently clothed with minute scale-like leaves, ovate, with a short apiculus.

The var. *grimsulana* in its extreme forms closely resembles *A. nivalis* in appearance.

*** Andreaea crassinervia** Bruch (Tab. IV. D.).

Differs from *A. Rothii* only in the stronger nerve, the limb of the leaf *very narrowly contracted* from just above the expanded base, *the lamina in the upper part extremely narrow*, sometimes ceasing below the apex *so that the nerve is slightly excurrent.*

Var. *β. Huntii* Braithw. (*A. Huntii* Limpr.). *Taller;* leaves longer with a narrower nerve. Perichaetial bracts shorter, obtuse or shortly apiculate, *papillose* at back.

HAB. Alpine rocks; apparently very rare. The var. *β*, Lake District.

In reading the descriptions given by various authors of this plant, one cannot but be struck with the uncertainty of the characters relied upon to distinguish it; what is held by one writer to be a distinctive character being held of no importance by another, so that one is compelled to doubt its stability as a species; and an examination of a considerable number of specimens has entirely confirmed me in this view; indeed, after carefully examining a large number of leaves of *A. Rothii* and of the present plant I am inclined to doubt whether it has a full title even to the rank of a sub-species of the former. According to Braithwaite, the leaves are of almost exactly the same form as in *A. Rothii*, or its var. *hamata*, only very narrow and subulate in the upper part, and with the nerve *apparently excurrent as a papillose subula;* but even this seemingly important distinction disappears when on closer examination it is found that the lamina is really continued to apex *in a single series of cells.* Now, I have frequently found forms of *A. Rothii*, and especially its var. *falcata*, to have the limb of the leaf more than usually narrow, with only *two* series of cells in its upper part; indeed, according to C. Müller, the var. *falcata* has the nerve "occupying the whole apex." The form of the leaf-base, oblong and gradually narrowed above, cannot be held characteristic, since in what are, I suppose, fairly typical speciments of *A. crassinervia*, viz., those gathered by Arnell at Hernosand, Sweden (*Musci Galliae*, No 697); the leaf-base is oval and quickly narrowed above, almost as in the var. *falcata*. The more regular, quadrate cells with thinner walls, held of importance by Boulay, may also be found in forms of *A. Rothii*. Again, with regard to the excurrence of the nerve, I have hardly ever found a leaf with the lamina really

ceasing below the apex, except in old leaves where it had possibly been removed by erosion ; in the large majority of cases where it appears excurrent I have found on close examination distinct indications that the single row of marginal cells *has* been so eroded ; and the papillosity of the subula in every case in which I have observed it, has been due to the slight erosion of the cell-walls of this row of cells as may often be found in the older leaves for a considerable distance below the apex ; I have never seen a young or unworn leaf with any trace of this papillosity. The width of the nerve I have also found variable.

The differences must therefore, I think, be held to be of a very slight nature and *A. crassinervia* must be considered little more than a variety of *A. Rothii* with an extremely narrow lamina reduced to one or two series of cells above and occasionally disappearing entirely just below the apex. Boulay (*Muscinées de la France*) describes the true *A. crassinervia* as having the nerve excurrent from below the middle of the leaf, a character sufficiently defined to separate it as a sub-species at least, although the other points which he holds characteristic are certainly of slight importance : but this form, or anything approaching it, has, I believe, never been found in Britain, and we must either exclude *A. crassinervia* from our list altogether or consider it, with Braithwaite and other authors, as including forms with a *very narrow* lamina continuous to apex, this feature and the general narrowness of the limb distinguishing it from *A. Rothii*, which, however, certainly passes into these less marked forms.

In support of this view we have the fact that Wilson always maintained that the three forms only constituted a single species ; also that the plant described as *A. Huntii* by Limpricht has been variously placed as a variety by some authors under *A. falcata*, by others under *A. crassinervia*. No doubt much confusion has arisen from the distribution of wrongly-named specimens ; this was the case with No. 394 of the *Musci Galliae*, which is only a form of *A. Rothii* with the lamina quite distinct to the apex ; and I have found the same feature in specimens supposed to be typical *A. crassinervia*, gathered by Whitehead on Penyghent.

I cannot think that the var. *Huntii* is entitled to the rank attributed to it by Limpricht. In plants from the Lake District with the tall robust habit and the perichaetial bracts as described by Limpricht, I find the leaves scarcely or not at all distinct from those of var. *falcata*.

B. CHASMOCALYX.

Perichaetial bracts like the leaves, distinctly nerved.

4. Andreaea nivalis Hook. (Tab. IV. E.).

Tufts *large, soft*, 2–4 inches high, purplish brown. Stem slender, flaccid, repeatedly branched, erect or decumbent, denuded at base. Leaves rather distant, secund, at the apex of the branches distinctly falcato-secund, soft ; the lower smaller, ovate-lanceolate; the upper *gradually lanceolate from an oblong base*, crenulate at basal margin, irregularly sinuose or notched in the upper part ; *strongly papillose on both sides*. Nerve *narrower* than in the last species, $\frac{1}{7}$ to $\frac{1}{8}$ the width of leaf at base, reaching to apex or vanishing just below ; prominent at back and papillose. Areolation *much paler and less opaque* than in the other species, irregularly rounded-quadrate above, at base more regularly quadrate, not elongate. *Dioicous ;* male flowers gemmiform, bracts numerous, imbricated, the inner nerveless ; perichaetial bracts elongate-lanceolate, resembling the leaves. Capsule opening by 4–6 valves, rather large.

Var. *β. fuscescens* Hook. Stems *more flexuose and flaccid*, with *strongly falcate* leaves of an olive brown colour.

HAB. Alpine rocks, near the snow line; very rare, Grampians, Ben Nevis, Ben Cruachan. The var. on Ben Nevis and Ben Macdhui.

There is no difficulty in distinguishing *A. nivalis* from the other species of the genus, but in the field it might possibly be passed over for the hepatic, *Herberta adunca*, to which it bears a considerable outward resemblance.

The var. *fuscescens* does not present very clearly definable characters; I have found both forms growing plentifully on the summit of Ben Nevis, and intergrading so closely that it is very difficult at times to distinguish the variety from the type. The former is more usually found fruiting, while the typical plant is more commonly found with male flowers; in Scandinavia the variety is the commoner form, and was therefore considered by Zetterstedt the type of the species.

This rare and interesting plant appears to be more at home on the Scotch mountains than in any other place, but it is found on several of the highest ranges of mountains on the Continent.

SUB-CLASS III. BRYALES.

Spores and Columella (the latter absent in Archidium) developed from the Endothecium, the Columella penetrating the spore-bearing layer (Archesporium). Spore-sac separated from the wall of the capsule by an air cavity. Capsule dehiscing irregularly or opening with a lid.

GROUP A. NEMATODONTEAE.

Peristome teeth solid, not transversely barred (very faintly only in Buxbaumia); derived from several concentric series of cells of the sporogonium.

DERIV.—From *νηματο-*(nēmato) thread, and *ὀδοντ-*(odont) tooth.

ORDER III. TETRAPHIDACEAE.

A small order of mosses distinct (except in the single species of the exotic genus Calomnium which is gymnostomous) in the peristome, composed of four solid conical homogeneous teeth, derived from the fission of the whole cellular tissue of the interior of the lid. Plants minute and gregarious, or caespitose and rather taller but slender. Leaves ovate or lanceolate, smooth, thinly nerved; areolation rounded-hexagonal. Calyptra conical, mitriform, plicate. Capsule oval or cylindrical, erect, symmetrical, smooth; annulus none. Inflorescence apical, gemmiform.

3. TETRAPHIS Hedw.

The characters of the genus are practically those of the Order as described above, the species being all peristomate. Braithwaite is no doubt right in re-uniting the two European species under this genus, the characters separating Tetrodontium being hardly of generic value.

A curious feature of the genus is the presence of peculiar "frondiform" leaves which appear on the protonema at the first development of the moss stem; they are more or less ligulate or spathulate from a narrower base, and in *T. Browniana* are sometimes forked above, somewhat as in the fronds of the Forked Spleenwort, or of the "Stagshorn" Fern; in this species they are persistent; in *T. pellucida*, on the contrary, they disappear before the development of the stem, and have on that account been overlooked.

The solid, undifferentiated teeth of the peristome appear to mark a primitive stage in the development of that organ. They are quite conspicuous with an ordinary pocket lens, and are not fragile nor deciduous, so that they form a ready means of distinguishing these plants from species of Barbula, etc., many of which in the fruit and general appearance are somewhat similar.

DERIV.—τετρα (tetra) four, alluding to the four peristome teeth.

Plant almost stemless, with radical frondiform nerveless leaves *2. Browniana*
Plant with leafy stem; barren shoots with terminal gemmiferous cups *1. pellucida*

1. Tetraphis pellucida Hedw. (*Mnium pellucidum L.; Georgia pellucida* Rabenh., Braithw. Br. M. Fl.) (Tab. IV. F.).

Plants in dense tufts, bright green above, reddish brown below, ½–1 *inch high*. Stems of two kinds, (1) fertile, simple or branched, with imbricated leaves, the lower broadly ovate from a narrow base, the upper more elongated and narrower, slightly decurrent; (2) *gemmiferous*, more slender and flexuose, with more uniformly rounded-ovate and more distant leaves, *ending in a cup of 4–5 broadly reniform bracts enclosing numerous paraphyses and stalked, lenticular gemmae*. Leaves very small at base of stems, larger above, erect when moist, carinate at back with the prominent nerve, when dry slightly undulated; margin plane, *entire;* nerve ceasing below apex; areolation *rounded*, at margin rather smaller and more closely set, the basal a little elongated, especially near the nerve. Autoicous, rarely synoicous. Male flowers apical, on special shoots arising from a sterile female flower, bracts ovate-lanceolate. Perichaetial bracts elongated, oblong-lanceolate, tapering but somewhat obtuse, nerved. Seta slender,

$\frac{1}{2}$–$\frac{3}{4}$*in. long*, brown, smooth, straight or flexuose ; capsule *narrowly cylindrical*, variable in length, green with a bright red top when young, bright reddish brown when ripe ; calyptra covering the capsule, white below, brown above, somewhat lacerate at base, distinctly plicate, at apex solid and rough ; lid thin, conical, acute, straight or oblique, glossy ; peristome teeth inflexed and meeting when moist, erect and open when dry, *narrowly* triangular, brown, *formed of linear cells*.

HAB. Turfy banks, peaty soil in woods, and rotten tree stumps. Widely distributed, but not abundant. Fr. all summer.

A very pretty and interesting species, which may readily be identified by the peristome, and when barren by the terminal gemmiferous cups which seem always to be present.

T. geniculata Girgens. an allied species found in N. America and Eastern Asia, differs in the absence of gemmae, longer narrower leaves, and especially in the geniculate pedicel, which is distantly tuberculate above.

2. Tetraphis Browniana Grev. (*Bryum Brownianum* Dicks. ; *Tetrodontium Brownianum* Schwaeg., Schp. Syn. ; *Georgia Brownii* C.M., Braithw. Br. M. Fl.) (Tab. IV. G.).

Very small, gregarious, *stemless*. Plant at first consisting of a tuft of radical, frondiform leaves, 2–3 layers of cells in thickness, narrowly clavate, or somewhat palmately branched at apex, brownish green, persistent for some time ; female flower produced among these leaves, developing into a perichaetium of 8–12 imbricated bracts, the outer very small, all ovate or ovate-lanceolate, obtuse or acuminate, with a faint nerve which disappears in the upper half, *margin entire, or more frequently crenulate-denticulate ;* cells *elliptical-rhomboid or narrowly rectangular*, rounded at the angles, with thick walls, at the base laxer and more regularly rectangular ; capsule on a smooth, brown, *much shorter and more rigid seta, very small, ovate*, firm, dark brown, solid ; calyptra darker, more deeply cleft at base ; mouth of the capsule more or less sinuosely notched between the peristome teeth, which are *much shorter, broadly triangular, of broader and shorter, rectangular cells*. Perigonial bracts fewer, nerveless.

HAB. Sandstone or gritstone rocks, frequently growing downwards from the roof of caves or clefts. Frequent in some parts of Scotland and the North of England, but not a common moss. . Fr. summer.

A minute plant, best distinguished in the field by the plicate calyptra and the peristome, from Seligeria, Brachyodus, etc. ; under the microscope it presents no resemblance to any other moss.

T. repanda Funck, a species or variety not found in this country, but known in France and elsewhere on the Continent, differs only in the frondiform leaves being replaced by minute flagelliform shoots bearing extremely microscopical nerveless leaves.

Order IV. POLYTRICHACEAE.

Plants usually of a large size, growing on earth, the simple or slightly branched stems springing from a creeping subterranean rhizome. Leaves usually narrow, the nerve more or less expanded on the ventral surface, and producing on that surface (occasionally also on the back of the lamina) longitudinal strips of tissue (*lamellae*) in the form of thin laminae standing on edge and running parallel to one another along the nerve, sometimes in great numbers and crowded, or few and lax, each usually a few rows of cells in height and a single cell in thickness, so as to appear in transverse section of a single row of superposed cells, the uppermost or external cell being often of a different form from the lower ones. Upper areolation generally hexagonal, with thin walls. Inflorescence nearly always dioicous, the male flower terminal, large, discoid. Capsule on a long seta, large, cylindrical, or prismatic with 2–6 angles. Calyptra narrow, cucullate, spinulose at apex, or with few or many erect or deflexed hairs. Peristome (in the European species) of 32 or 64 short, ligulate, unbarred teeth, triangular in transverse section; columella expanded at apex into a shield-shaped membrane, the epiphragm, or, as it is sometimes rather inaccurately called, the tympanum, covering the mouth of the capsule and united at its edges with the teeth of the peristome (Tab. IV. H. 6).

The larger species of this Order, being very noticeable plants and also common, are among the first which come under the notice of the student of mosses, and will be easily referable to their right Natural Order by the lamellose face of the leaf, which in Polytrichum renders almost the whole surface dark green and opaque: the lamellose-leaved species of the Tortulaceae will be readily distinguished by their small size and small fruit, being usually fertile. The leaves among the Polytrichaceae are among the largest, especially in point of length, of any mosses.

The stem in Polytrichaceae, as well as the seta, shows a higher development than in any other Order, there being a specialised central axis, the tissue of which, both in anatomy and function, shows an approach to the central fibro-vascular bundle in the Vascular Cryptogams. An interesting discussion on this and other points in reference to the Polytrichaceae by J. R. Vaizey will be found in the Journ. of the Linn. Soc., Botany, Vol. XXIV., p. 262, "*On the Anatomy and Development of the Sporogonium of the Mosses.*"

The structure and function of the peristome and epiphragm are of great interest, and the student is referred to the description of these parts in Dr. Braithwaite's British Moss Flora, and in Philibert's admirable papers on the peristome in the Revue Bryologique.

Besides the British genera, there are two exotic genera of importance, Dawsonia and Lyellia.

4. **CATHARINEA** Ehrh.

(Atrichum *P. Beauv.*, Schimper Syn., et plur. auct.)

Stems moderately tall, leaves slightly embracing the stem, but *not sheathing, nor narrowed above the base*, lingulate or ovate-oblong, crisped when dry, bordered and serrate, generally undulated, with *few straight lamellae above*. Calyptra *without hairs, spinulose-papillose at apex*. Capsule *smooth*, oval or cylindric, *curved ; lid long-beaked ;* peristome of 32 teeth, with a narrow basal membrane. Inflorescence usually dioicous.

DERIV.—After the Empress Catherine II. of Russia.

1 { Ls. narrow-lingulate, cells 12–27 μ 2
  { Ls. wider, oblong, lamina smooth at back, cells 25–45 μ ..... *4. crispa*

2 { Lamellae about 5–7 ; capsule suberect, cylindric ..... *3. angustata*
  { Lamellae about 2–5 ; capsule arcuate, or suberect and very short 3

3 { Capsule arcuate, cylindric ; autoicous or paroicous ..... *1. undulata*
  { Capsule inclined, oblong ; dioicous ..... *2. tenella*

1. Catharinea undulata Web. & Mohr (*Bryum undulatum* L., *Atrichum undulatum* P. Beauv., Schp. Syn.) (Tab. IV. H.).

Plants in loose patches, dull green, in open dry spots yellowish ; stems erect, 1–2 inches high, simple or bifid, from a much branched, rooting, underground rhizome ; leaves very small below, scale-like, gradually longer above, in the upper part very longly lingulate, 2–3 lines long, *strongly transversely undulate*, chiefly in the upper half, much crisped and incurved when dry, flexuose and patulous when moist, acute or somewhat obtuse, bordered with a narrow, distinct margin of 2–3 rows of very narrow, brownish, cartilaginous cells, *sharply spinose for the greater part of its length* with strong teeth, usually in pairs ; the surface of the leaf also, at the back, in the upper half and especially near the apex, is beset with somewhat similar spines, usually in transverse rows, on the crests of the undulations ; nerve vanishing in the apex of the leaf, sharply spinulose at back above ; areolation rather large, chlorophyllose, in the upper part of the leaf hexagonal or elliptic-hexagonal (with the longer axis transverse to the direction of the leaf, *i.e.*, broader than long), gradually becoming larger and quadrate below, elongate-rectangular at the base. Lamellae 2–4, more rarely 5 or 6, straight, the upper margin very bluntly notched ; in section each of *3 to 5* (rarely 2–7) nearly equal, smooth rounded cells. Cells of leaf and lamella 18–22 μ in diameter. *Inflorescence autoicous*, functionally dioicous. Male flower terminating the first year's stem, the axis of which is subsequently prolonged, and next year produces a terminal fertile flower. Perichaetial bracts longer and narrower, but otherwise resembling the leaves. Seta erect, flexuose, reddish brown, 1–1¼ inches long, often two or more together from the same perichaetium ; capsule cylindrical, variable in length, *strongly arcuate*

and inclined, brown, thick-walled, lid subulate, curved, almost as long as the capsule. Calyptra pale, rough at apex, covering about one-third of the capsule. Teeth of peristome long, lanceolate, obtuse, the median line orange, the edges pale, basal membrane reddish.

Var. *β. minor* W. & M. *Stem short, leaves short*, less undulated. Capsule *shorter*, suberect, unequal, on a shorter pedicel.

Var. *γ. Haussknechtii* Dixon (*Catharinea Haussknechtii* Broth., Braithw. Br. M. Fl., Vol. II. Suppl.; *Atrichum Haussknechtii* Jur. & Milde).

Inflorescence terminal, *paroicous* or perhaps rather *synoicous*; antheridia central, with suddenly accuminate almost entire bracts, surrounded by a row of archegonia. Two or more capsules are produced from the same perichaetium; subsequently the axis is produced as in *C. undulata*, so that the fruitstalks, which are persistent for a year or more, *appear lateral*, a new inflorescence and fruit being formed at the fresh apex in the following year; in this way the old fruitstalks of one or two years' growth may be seen on the side of the stem.

Hab. On sandy soil or clay, in woods, on heaths, etc., very common. The var. *β* in drier, stony places. The var. *γ* rare. Fr. late autumn and winter.

A very common plant, with the aspect of which the student soon becomes familiar; it has little resemblance to any other species—beyond those of its own genus—except *Mnium undulatum*, which might sometimes be confused with it, but which is easily distinguished by its marginal teeth being single, not in pairs, the basal cells not regularly rectangular, the broader margin, percurrent nerve, etc. The characters distinguishing it from *C. angustata*, *C. tenella*, and *C. crispa* are described under those species.

Within slight limits it shows a considerable variation, chiefly in the form and size of capsule, the apex of the leaves more or less acute, and the amount of their undulations; the var. *minor* is not much more than a starved form, and may be found growing with the type with intermediate forms.

The var. *Haussknechtii* is probably rather a sport than a true variety. The inflorescence is an exceedingly unstable character in *C. undulata*, male flowers are occasionally repeated two or three times on the same stem. The setae are frequently aggregated even when the inflorescence is otherwise normal, and other variations occur. In plants with the synoicous inflorescence and the aggregate and lateral setae of the variety I have found no correlation with the form of leaf and of capsule described by those who regard *C. Haussknechtii* as a species. A single patch will often display a great variety of forms in these respects.

2. Catharinea tenella Roehl. (*Atrichum tenellum* B. & S., Schp. Syn.) (Tab. IV. I.).

Resembling *C. undulata* var. *minor*. In loose tufts, dull or yellowish green, stems ½–1 inch high, simple. Upper leaves *oblong-lanceolate or lanceolate, short*, 1½–2 lines long, scarcely undulate, with very few or no spines at back, border spinose to below the middle. Lamellae 2–4, each of 3–6 rows of cells. Leaf

cells 18–27 μ in diameter. *Dioicous*. Seta short, less than 1 inch, yellowish, becoming red later. Capsule *very short, obovate or oblong*, slightly inclined. Calyptra *almost smooth*.

HAB. On sandy and clayey ground, usually in moist places. Very rare. **Kent, Wilts., Fife, Inverness. Fr. autumn.**

Extremely close to *C. undulata* var. *minor*, and scarcely separable from some of the most extreme forms of that variety, except by the dioicous inflorescence. As a rule, however, the small size of all its parts, together with the leaves scarcely at all undulate, at back almost smooth, render it easy of identification. The leaf cells, especially in the lower leaves, are slightly larger than in *C. undulata*. According to Limpricht, it differs also in the *yellowish* seta, more *quadrate* cells of the exothecium, and in the earlier time of fruiting—August and September. The ripe seta, however, in my specimens is frequently deep red, becoming much darker when old: and the cells of the exothecium in no way differ from those of *C. undulata* var. *minor*, being both quadrate and rectangular in the same capsule. I do not think the time of fruiting can be relied upon; specimens gathered in December have several of the capsules still operculate and immature: and I have gathered the plant in Norway in the beginning of August with the seta only just developed. Occasionally an old inflorescence may be found on the stem below the fruiting perichaetium but it will be found on examination that it is a female flower, not a male one, as in the case of *C. undulata*.

C. crispa differs in the taller stems, larger, more loosely set leaves, and much larger cells, etc.

3. Catharinea angustata Brid. (*Atrichum angustatum* B. & S., Schp. Syn.) (Tab. V. A.).

Much like small forms of *C. undulata*, but with short, simple stems, and of a more reddish tint. Leaves crowded, straighter and more erect, oblong-lanceolate, shorter, *obtuse, less undulate*, more sparingly and less sharply spinulose at back, with *smaller areolation;* the margin with smaller teeth, *serrate only in the upper half* or with only a few very minute teeth below the middle; lamellae *more numerous*, 5–7, *higher*, in section each of 5–9 equal cells. Leaf cells and cells of lamellae *smaller*, 12–14 μ in diameter. Dioicous, male flowers cup-shaped, growing on separate tufts of plants. Capsule nearly erect and *only slightly arcuate or almost straight;* narrower in proportion to its length than in *C. undulata*.

Var. β. *rhystophylla* (C.M.) Dixon (*C. rhystophylla* C.M.). Leaves *strongly undulate, sharply toothed* at both margin and back.

HAB. In similar situations to *C. undulata*, but much rarer. Found in several counties of England and not rare in Sussex; Perthshire. The var. β rare; Kent; Sussex; Co. Down. Fr. winter.

C. angustata, though a distinct species, is separated rather by a combination of characters, most of which may, at one time or another, be found to some extent in *C. undulata*, than by any very clearly defined and obvious character: apart from the inflorescence, however, the character of the lamellae will usually serve to separate the two species. In *C. undulata* they are few and short, so that when flattened out on each side of the nerve, as by the pressure of a cover-glass, the space occupied by them only amounts (in the upper half

of the leaf) to about $\frac{1}{8}$ to $\frac{1}{10}$ of the total width of the leaf; whereas in the present species they will be found to cover, under the same circumstances, $\frac{1}{4}$ and even $\frac{1}{3}$ of the width; the smaller cells and much weaker serration of the leaf margin are also distinguishing features. The plant has, however, a distinct appearance of its own, and I have found it quite possible to distinguish it in the barren state, even from the smaller forms of *C. undulata* with which it sometimes grows, and without the aid of a lens, by the more lurid colour, and the more erect, less undulate leaves. The leaf characters will also in the absence of fruit separate it from *C. tenella*. The narrower leaves, spinulose at back of lamina, will distinguish it from *C. crispa*. It is a much commoner species in N. America than in Europe. Like *C. undulata*, it varies very considerably in length of capsule.

The var. β is a striking plant in its extreme forms, but it has no distinct structural characters, and is connected with the type by intergrading forms.

4. Catharinea crispa James (*Atrichum crispum* Sull., Schp. Syn.) (Tab. V. B.).

In soft *tufts*, dull or yellowish green. Stems tall, erect, simple, 2–4 inches high. *Leaves distant*, rather large, *oval-oblong or oblong-lanceolate*, the lower shorter and broader, patent, when dry crisped, *hardly at all undulate*, obtusely acuminate; nerve strong, reddish brown, vanishing in the apex, with a few rather blunt teeth at back above; border reddish, dentate from near the base, teeth smaller than in *C. undulata*, less frequently in pairs; *lamellae very low and indistinct*, 1–4, somewhat undulate on the margin and frequently interrupted, vanishing in the lower half of the leaf, in section of *1–3* rather large equal cells. Areolation *larger than in any of the previous species*, 25–45 μ, elongate towards base and less chlorophyllose, the upper quadrate-hexagonal or rounded, smaller towards the margin, not spinose at back. Dioicous; male plants taller, in separate tufts. Setae slender, often two or three together, somewhat flexuose; capsule erect or nearly so, slightly curved, *narrowly obconical*, wide-mouthed; lid conical with a subulate beak. Peristome teeth narrow, unequal, basal membrane very narrow.

Var. β. *densifolia* Lindb. Dwarf; *leaves crowded, broader* and more elliptical, patulous.

Hab. Sides and beds of rocky streams, among grass or in sand; rare. Male and barren plants only. The var. β at Oakmere, Cheshire.

The fertile plant has been found in N. America only; the stem is shorter, the leaves longer and closer than in our plants. The laxer areolation and the few and indistinct lamellae will easily distinguish it from the other species; indeed, it is much more likely to be confounded with *Mnium hornum*, which it closely resembles, but a careful examination will detect the presence of lamellae, though they are sometimes so slightly developed that, without care, they are liable to be overlooked; the cells in *Mnium hornum* are moreover distinctly smaller than in our plant.

The large tufts in which it grows are often embedded almost up to the tops of the stems in sand or *débris*.

5. **OLIGOTRICHUM** De Cand.

Stems simple, from a subterranean rhizome. Leaves oblong or linear-lanceolate, not contracted above the sheathing base, *concave, with numerous sinuose lamellae in front* and a few at back. Dioicous. Capsule erect, ovate-oblong; *calyptra with a few scattered erect hairs;* teeth of peristome slender, irregular.

Intermediate between *Catharinea* and *Polytrichum*.

DERIV.—ὀλιγο-(oligo) few, and τριχο-(tricho) hair, alluding to the calyptra.

1. Oligotrichum hercynicum *Lam.* (*Catharinea hercynica* Ehrh.; *O. incurvum* Lindb., Handb. Ed. I, Braithw. Br. M. Fl.; *O. exiguum* Stirt. in Ann. Scot. Nat. Hist. xvi., 173) (Tab. V. C.).

Loosely caespitose, *glaucous green*, reddish brown when old. Stems about one inch high, erect, rigid, unbranched. Leaves small and distant below, crowded above, erect or spreading, when dry strongly incurved or twisted, but less crisped and undulate than in Catharinea, lanceolate from an oblong, thin, sheathing base; concave, more or less acute, *not bordered*, margin incurved, especially above, *remotely and minutely dentate, coarsely notched at apex;* areolation small, regularly rectangular at base, then quadrate, in upper part of the leaf irregularly hexagonal; nerve with lamellae on both sides, at the back few (3–5), short, bluntly serrate, low, and rather in the form of ridges than lamellae; *on the upper surface numerous, 10–12,* high, *sinuose* from side to side when viewed from above, occupying about one-third or half the width of leaf in upper part, their *upper margin variously notched and crested;* in section of *6–12* equal cells. Dioicous; male plants shorter, flowers brownish red, discoid. Capsule on a rather thick seta, which is ¾–1 inch long (rarely 1½ in.); *ovate-cylindrical,* erect or somewhat inclined, somewhat plicate when dry, and contracted below the mouth; lid shortly rostrate, oblique, often falling off with the calyptra; columella four-winged; peristome teeth short, unequal.

Var. β. *laxum* Braithw. Stem taller, *2–4 inches high,* slender. Leaves more distant, spreading, *pellucid, with fewer lamellae,* and *much larger cells,* more distinctly toothed. Barren.

HAB. Sandy and stony ground on or about mountains. The var. β rare; Ben Nevis; Lake District; Snowdon, and other places in Wales. Fr. late summer.

In this species, as in Polytrichum, the axis of the male plant is produced and continues growing beyond the first year's perigonium; producing another in the following year, so that two or three perigonia may be found one above the other on the same stem.

Although the lamina of the leaf is not spinose at back, a few short, toothed *lamellae* may frequently be found, principally near the apex. A very curious form which I gathered near Llyn Dinas, Beddgelert, somewhat intermediate between the type and the var. *laxum*, has stems 2–4 inches long, *frequently branched*, with the leaves much crisped when dry, pellucid and with few lamellae as in var. *laxum*, but with cells quite as small as in the type, and numerous short lamellae scattered over the back of the lamina near apex, principally near the margin.

The name *incurvum* must give place to *O. hercynicum*, as the older specific name.

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6. **POLYTRICHUM** Dill.

Plants varying in size, often tall and showy, the stems innovating from creeping underground rhizomes, occasionally branched above. Leaves large, *suddenly narrowed above the membranous, sheathing base, not bordered;* the nerve broad, sometimes toothed but not lamellate at back, covered on the upper surface with *numerous straight lamellae, occupying the greater part of the width of the limb*, and rendering the leaf rigid and opaque; lamellae entire or crenulate along the upper margin, *not coarsely toothed*. Dioicous (in the European species). Calyptra covered with a *thick felt of deflexed hairs* reaching far below its base and usually covering the greater part of the capsule, or the whole. Capsule erect or cernuous, cylindrical or angular, with or without apophysis. Lid plane or convex, with a subulate beak. Teeth of peristome 32 or 64.

A large genus, exhibiting much variety in size, but very uniform in the general arrangement and form of the leaves. The character of the apical cell of the lamellae when seen in section is of great value in distinguishing the species, especially when barren; and the upper edge of the lamellae, viewed laterally, is often of importance. A valuable paper on this, by W. R. Sherrin, will be found in Journ. of Bot., Apr., 1918.

DERIV.—*πολυ* (poly) many, and *τριχο*-(tricho) hair; from the hairy calyptra.

1 { Leaf-margin entire, inflexed over the lamellae (capsule angled) 2
  { Leaf-margin more or less toothed, not inflexed 5

2 { Ls. bluntish, more or less cucullate at apex, nerve scarcely excurrent ..... *5. sexangulare*
  { Ls. aristate at apex 3

3 { Arista long, hyaline, very rough ..... *6. piliferum*
  { Arista short, coloured 4

4 { Stem not tomentose; ls. spreading; capsule oblong ..... *7. juniperinum*
  { Stem densely tomentose; ls. erect; capsule small, cubic ..... *7*. strictum*

5 { Capsule 4–6 angled; ls. with narrow tapering points, border-cells of lamellae smooth 6
  { Capsule not angled; ls. either with short wide points or with border-cells of lamellae papillose 8

6 { Capsule cubic, sharply angled; border-cells of lamellae grooved longitudinally ..... *10. commune*
Capsule oblong; border-cells of lamellae similar to the rest, not grooved...7

7 { Capsule distinctly angled; basal cells of ls. very long and narrow *9. formosum*
Capsule obscurely angled; basal cells shorter and wider.....*8. gracile*

8 { Ls. with short, wide points, border-cells of lamellae similar to the rest, thin, smooth 9
Ls. with long, narrow points; border-cells of lamellae large, thickened, papillose 10

9 { Capsule very short, columella cylindric; ls. bluntly toothed.....*1. nanum*
Capsule cylindric, columella winged; ls. sharply toothed.....*2. aloides*

10 { Capsule cylindric, erect or nearly so; border-cells of lamellae round *3. urnigerum*
Capsule tumid, inclined; border-cells oval.....*4. alpinum*

A. POGONATUM.

Capsule oval or cylindrical, in transverse section circular; not or hardly apophysate.

1. Polytrichum nanum Neck. (*P. subrotundum* Huds., Braithw. Br. M. Fl.; *Pogonatum nanum* P. Beauv., Schp. Syn.) (Tab. V. D.).

Plants gregarious, deep green; *stems very short*, ¼–½ inch high, simple, naked below, intermixed with green protonema at base. Leaves from an erect sheathing base, spreading, with a lingulate or ovate-lanceolate limb, obtusely pointed, with the margin erect at apex, *bluntly toothed from about the middle of the limb*, the teeth brownish, composed usually of a single cell, remote below, more crowded above; nerve percurrent, bluntly toothed at back of apex, very broad on the face of the leaf, and covered with *30–40* lamellae, occupying the greater part of the limb to near its base, in section of 6–8 small equal rounded cells. Areolation rounded-hexagonal above, hexagonal at base of limb and basal margin, narrow-rectangular at mid-base. Seta thin, flexuose, variable in length. Capsule small, erect or inclined, *oval or almost spherical*, with a rostellate lid, wide-mouthed and turbinate after the fall of the lid, *minutely punctate* with very fine papillae. Calyptra hardly reaching the base of the capsule. Peristome teeth 32, rather large in proportion to the size of the fruit. *Columella cylindrical.* Spores 14–18 μ.

Vas. β. *longisetum* Hampe. Leaves *longer*, narrower; *seta long*, 1–1½ inches; capsule oval-oblong.

HAB. Sandy ground on banks and heaths. Frequent. The var. β rare. Fr. usually winter and spring, but variable.

There is considerable variation in the length and the serrature of the leaves, length of seta, and form of capsule; but the present species is generally sufficiently distinct from the next by the obtusely serrate leaves, and in

doubtful cases the cylindrical columella, without wings, and the surface of the exothecium cells, will clearly distinguish it. With a low power the capsule wall appears smooth or only slightly and irregularly mamillate; it is only under a higher magnification that the minute papillae become visible. The whole surface of the capsule in *P. aloides* is scabrous with very large conical papillae, one crowning each cell of the exothecium. Fortunately for the student, the species of this genus, although dioicous, are usually fertile, and the fruit is of great aid in the determination of the species.

2. Polytrichum aloides Hedw. (*Pogonatum aloides* P. Beauv., Schp. Syn.) (Tab. V. E.).

Usually more elongated in all its parts than the last species; stem taller, $\frac{1}{2}$–$\frac{3}{4}$ inches high, sometimes forked. Leaves *longer*, linear-lanceolate, obtuse or acute, densely and *sharply serrate from the base of the limb*, several cells usually entering into the composition of each tooth. Lamellae more numerous, *40–60*, lower, in section of 3–5 cells. Calyptra slightly narrower, covering the entire capsule, which is *oblong-cylindrical*, erect or slightly inclined; constricted below the mouth and urceolate after the fall of the lid, distinctly and *highly papillose* over the whole surface; greenish brown or brown. *Columella four-winged.* Peristome teeth shorter. Spores 8–12 μ.

Var. β. *Dicksoni* Wallm. (*Polytrichum Dicksoni* Turner; *Pogonatum aloides* var. *defluens* Brid., Schp. Syn.). *Dwarf; seta very short*, capsule *obovate*, finally urceolate or turbinate; hairs of calyptra sometimes confluent below the capsule.

Hab. Dry banks, disused quarries, etc. A much more frequent species than the last. The var. β not common. Fr. as in *P. nanum.*

Much like the last species and similarly variable, but quite distinct as noted under that plant. These two species are often separated from the following under the title Aloidella, derived, like the specific name of the present species, from the solid, toothed, aloe-like leaves. The two following species are taller, more branched, with longer, more pointed leaves.

3. Polytrichum urnigerum L. (*Pogonatum urnigerum* P. Beauv., Schp. Syn.) (Tab. V. F.).

Stems in lax patches, rigid, erect, 1–3 inches high, innovating laterally, sometimes twice or thrice forked or with several close, crowded, fasciculate branches; *glaucous green*, brown below. Lower leaves scale-like, apiculate, upper *lanceolate* from a pale sheathing base, patulous when moist; rigid, appressed to stem, erect or slightly incurved when dry; crowded, long, at apex *acuminate to an acute point* formed by the slightly excurrent nerve, which is sharply spinose at back. Limb plane, sharply toothed at margin from near the base; areolation of the base narrowly rectangular, without chlorophyll, whitish brown, of the limb quadrate-hexagonal or rounded, at base of limb very narrowly transversely elliptical, small and dense. Lamellae *about 50*, low,

very much crowded, in section of 4–6 cells, *the uppermost cell larger, rounded*, yellowish brown, *papillose*, the rest smooth, green. Seta rather long, 1–1½ inches, slender, pale reddish. *Calyptra longer than capsule.* Capsule *erect* or very slightly inclined, *symmetrical*, resembling the last, but larger and somewhat more cylindrical, *wide-mouthed*, golden brown, finally brown, very papillose, without stomata. Lid with an almost straight, subulate beak. Teeth of peristome reddish.

Var. β. *humile* Wahl. (*Pog. urnigerum* var. *humile* Brid.). Stems *short*, simple, scattered; leaves shorter. Capsule narrower and *smaller*, on a *shorter seta.*

HAB. Dry and stony places; most common in subalpine situations; the var. β in drier, more exposed situations, rare. Fr. autumn and winter.

The glaucous colour will usually distinguish the present from the next species, as also the erect, symmetrical, papillose capsule. The var. *humile* is perhaps rather a starved form than a permanent variety.

P. capillare Rich., found in Scandinavia, and common in N. America, is somewhat intermediate between this and *P. aloides*; with the habit of the latter it has very sharply serrate leaves, the teeth being often patent and recurved. The European form (*Schp. Syn. Ed. 2, p. 536*) is, however, not so strongly marked.

4. Polytrichum alpinum L. (*Pogonatum alpinum* Roehl, Schp. Syn.) (Tab. V. G.).

Stems loosely or densely tufted, tall, much branched, decumbent at base. Leaves *dull green*, rather longer and more flexuose than in the last species, more narrowly acuminate, the serratures slightly less acute in outline; lamellae fewer, *about 35*, less crowded, *higher, in section of 5–8 cells*, the marginal ones larger, *ovate-conical, papillose*, yellowish. Seta long, flexuose. Capsule *inclined and arcuate*, variable in size and form from sub-globose to elongate-cylindrical and curved, usually oblong-cylindrical, and somewhat gibbous on the upper side, *narrower at the mouth than below, not papillose*, with a short neck, bearing stomata, greenish brown, blackish when old and rugose; lid with a long, curved, subulate beak; *calyptra shorter than the capsule.* Peristome teeth short and irregular.

Var. β. *silvaticum* Lindb. (*P. silvaticum* Menz., *Pog. alpinum* var. *arcticum* Brid., Schp. Syn.). Stems slightly branched; *capsule elongate, cylindrical, narrow*, curved, softer, with a less distinct neck.

Var. γ. *septentrionale* Lindb. (*Polytrichum septentrionale* Swartz). Stem short; leaves slightly subsecund, shorter; capsule *oval-globose, suberect.*

HAB. Stony and grassy places on mountains and moors. Frequent. Fr. late summer.

Readily distinguishable in almost all cases by its curved, asymmetrical capsule, without angles, and almost always smaller at the mouth, not wider as is that of *P. urnigerum*; in doubtful cases the other points, italicised above, will amply suffice to determine it. It is a most variable plant in size, and in the form and magnitude of the fruit, and the many varieties that have been described are far from constant. The var. *silvaticum* represents one extreme, with tall stems, long loose leaves, and very long, narrow capsule. The other extreme is reached in var. *septentrionale*: here the tufts are dense, the leaves close and short, the capsule small and subglobose. I have seen no British specimens of var. *silvaticum*, nor do I know of any certain records. The var. *septentrionale* I have not seen recorded, but I have gathered a form on Slieve League, Co. Donegal, and on one or two of the higher Scotch mountains, which appears to be referable to this variety; the seta is often barely ¾ of an inch long, and many of the capsules are hardly longer than broad. Intermediate forms approaching this variety are numerous. It is merely through a wrongly named specimen that *P. septentrionale* Sw. has been referred to *P. sexangulare*. The var. *campanulatum* appears an unsatisfactory form, and I have not retained it.

B. Eu-Polytrichum.

Capsule with 2–6 usually acute angles; apophysis generally well-defined. Peristome teeth 64.

5. Polytrichum sexangulare Floerke (Tab. VI. E.).

Stems erect or decumbent, usually 1–2 inches high, occasionally 2–5 inches, simple or slightly divided, rigid, in tufts or loose patches, not tomentose at the base. Leaves short, *rather obtuse*, linear-lanceolate from a broad sheathing base, patent when moist; the lower ones glossy, dark coloured; when dry closely imbricate, rigid, incurved at apex; *margin entire, incurved from near the base of limb, at apex cucullate*. Lamellae *30–35*, in section of 4–6 cells, the marginal one larger, ovate-conical, *smooth*. Upper margin of the lamellae, viewed laterally, *quite entire*. Seta rather thick, short, ½–1¼ inches. Calyptra *not covering the capsule*. Capsule erect or inclined, oval, *with 6 obtuse angles*, reddish brown; apophysis obconical, not constricted to a neck above; lid with a rather thick beak. Peristome of 64 teeth, short, unequal.

Hab. Summits of the higher Scotch mountains, where the snow lies till late; very rare; Ben Macdhui and others of the Cairngorm range; Ben Nevis; Aonach Mor; Ben Laoigh; Ben Lawers; barren on the two last-named, occasionally fertile on the others. Fr. late summer.

A very rare plant with us, readily distinguished in the field by the short, obtusely cucullate leaves with entire inflexed margins. *P. strictum* and *P. juniperinum* differ in the very acute, more or less aristate leaves. The upper margin of their lamellae, also, viewed laterally, is highly crenulate. In *P. sexangulare*, although the general outline of the leaf apex is obtuse, it will be found under the microscope that the nerve is excurrent in a short mucro, which, though rather blunt, gives a more acute outline to the leaf than appears with the lens. The capsule, as is usually the case in this section, becomes more inclined or even horizontal when old. The angles are sometimes obscure.

I have gathered the plant with stems nearly 6in. long, and fruiting abundantly, on Aonach Mor, the adjoining mountain to Ben Nevis, but the capsules rarely become well-matured, owing to the short time that they are freed from the snow.

6. Polytrichum piliferum Schreb. (Tab. VI. A.).

In loose tufts, glaucous green. Stems erect, simple, rarely forked, 1–1½ inches high, naked at base. Upper leaves rapidly lengthening, so as to form an elongate coma, when dry closely appressed and straight, forming a narrow ovoid or clavate head. Base of leaf narrower and longer than in the preceding species, limb narrowly lanceolate, the wings broad, *inflexed* upon the front of the leaf and almost meeting, formed of narrow transversely elliptical cells, *entire ;* nerve reddish, at apex *suddenly becoming hyaline*, and excurrent as a *long, denticulate, hoary arista ;* apex of leaf, below the arista, minutely scabrous, *smooth at back of nerve*. Lamellae *about 30*, in section of 4–7 cells, the uppermost larger, elongate, broader in the middle, narrowed above and below, so as to appear obtusely cruciform, not papillose. Perichaetial bracts longer, the inner thin, whitish, without lamellae, longly aristate. Seta 1–1½ inches long ; capsule covered by the calyptra, erect, inclined when dry, *small*, shortly oblong, *with 4 sharp angles*, and occasionally an intermediate fainter one ; apophysis distinct, short, constricted above, where it passes into the capsule ; lid shortly and stoutly beaked, red or orange. Male plants with shorter leaves, more shortly aristate.

HAB. Dry heaths, common. Fr. summer.

P. piliferum varies little, and may readily be known by the hoary leaf-points and small capsule. An alpine form (*Pol. Hoppei* Hornsch.) has shorter leaves, longer hair-points, and shorter, broader capsules, on shorter setae. The cup-shaped male inflorescence in this and the following allied species is bright red or orange, and forms a conspicuous picture in the places where it grows. A form from Co. Wicklow has the hairs of the immature calyptra of a beautiful rosy red.

7. Polytrichum juniperinum Willd. (Tab. VI. C.).

Stems scattered, taller than in the last species, 1–4 inches, rarely branched, glaucous green, sometimes slightly tomentose at base. Leaves less crowded at the top of the stems, spreading when moist, erect when dry, *long*, lanceolate from an oblong base as in *P. piliferum*, the wings *inflexed*, but not so nearly meeting as in that species, *entire ;* nerve excurrent in a *shorter, red, dentate arista, strongly toothed at back of apex* and often half-way down the limb. Lamellae *35–40*, in section nearly as in the above species. Perichaetial bracts longer than the leaves, and with a longer arista, white and membranous at edges. *Calyptra large*. Capsule on a longer, bright red, shining seta, 1½–2½ inches high ; *larger, tetragonal-oblong*, with sharp angles, lid deep red, beak short ; apophysis short, less distinct. Male plants more slender, with shorter leaves.

HAB. Heaths and waste places ; common. Fr. summer.

An alpine form (var. *alpinum* B. & S., *Pol. boreale* Kindb.), is shorter and more stunted in all its parts, with longer hair-points to the leaves, the tip sometimes hyaline. Prof. Barker has gathered a plant in Wales showing a distinct approach to this variety, the upper leaves having the nerve prolonged into a long, fine piliferous point; but the other characters hardly admit of its reference to the variety.

The calyptra in this species is often very pale, sometimes almost white.

* **Polytrichum strictum** Banks (Tab. VI. B.).

Differs from *P. juniperinum* in the *taller, more slender stems;* rigid, almost terete when dry with the short appressed leaves; sometimes nearly a foot high, usually covered for a great part of their length with *dirty white tomentum,* densely tufted, slightly branched. Leaves *erecto-patent, shorter, narrower, straight;* erect, *closely and regularly imbricated when dry;* lamellae fewer, 25–30. Capsule smaller, *cubic or very shortly rectangular;* calyptra small.

Hab. Boggy heaths. Not common.

The characters which separate this plant from *P. juniperinum,* though chiefly comparative and insufficient to justify giving it specific rank, are fairly stable, and it seems to fill its right place as a sub-species. The habitat, among other points, is quite different; it is not unfrequently found mixed with Sphagnum. The very slender, terete stems, with short, regularly imbricated leaves, are, in the dry state especially, very noticeable.

8. Polytrichum gracile Dicks. (Tab. VI. D.).

Densely tufted, dark green; stems 1–4 inches high, matted together below with whitish, radicular tomentum, simple or slightly divided, leafless below, the fertile stems with the leaves crowded above into an oblong tuft. Leaves erecto-patent, somewhat flexuose or curled when dry, *short,* the upper 4–5 lines long, the limb lanceolate, gradually narrowed to a sharp acumen, margin of lamina erect, sharply serrate, variable in width, usually of about *4–6 rows of cells* in the middle of the limb, sometimes more, *the cells rather large,* 15–18 μ in diameter, rounded-quadrate or transversely elliptical. Cells of the sheathing base thin, rectangular, about *3–4 times as long as broad* in middle of wing. Nerve excurrent in a short, acute, red, dentate point, spinose also at back in the upper part of the leaf. Lamellae *about 40,* each in section of 4–6 cells, *equal in size, smooth and rounded.* Perichaetial bracts longly sheathing. Capsule on a thin flexuose seta $1\frac{1}{2}$–2 inches long, erect, horizontal when dry, *short, broadly ovate, inflated,* with *5–6 obtuse and often obscure angles, narrowed at the mouth,* apophysis rather indistinct, hardly constricted above. Calyptra hardly covering all capsule. Lid large, with a *rather long beak.* Peristome teeth 64, but often confluent, and unequal. Cells of exothecium smooth, not turgid. Spores 18–22 μ.

Hab. Peaty woods and dry heaths on turf. Frequent. Fr. summer.

The distinguishing characters are difficult to define, and may, perhaps, be best pointed out by comparison with the allied species, *P. commune* and *P. formosum*, the only two which are likely to be taken for it. It differs from both in the wider leaf-margin and distinctly wider cells throughout the leaf, the fewer lamellae, and the more obscurely angled capsule, almost invariably shorter and more inflated than in the latter species. The smaller vars. of *P. commune* closely resemble it, and here, perhaps, the most certain character is to be found in the smooth rounded apical cells of the lamellae of the present species; the beak of the lid is also usually longer, and the capsule wall smooth.

Barren specimens of *P. alpinum* are distinguishable by the papillose marginal cells of the lamellae.

The number of lamellae, and consequently the width of leaf-margin, varies considerably, but the latter is always more developed in proportion to the former than in the related species, in consequence of which the leaves are usually more crisped and flexuose when dry. Occasionally the lamellae become very few, as in the remarkable form gathered by me near Northampton (v. Braithw. Br. M. Fl., Vol. I., p. 295), presenting all the appearance of a Catharinea, and indeed so named at first by Dr. Braithwaite; in these cases the leaf-cells become larger and chlorophyllose, the leaves tend to widen, and the distinction between limb and base disappears. As the lamellae serve, functionally, to replace the chlorophyllose tissue of the leaf lamina of most mosses, these latter features doubtless arise as a compensation for the diminution in the lamellae, and probably mark, in fact, a reversion to an earlier type.

9. Polytrichum formosum Hedw. (*P. attenuatum* Menz., Braithw. Br. M. Fl.) (Tab. VI. F.).

Plants tall, loosely tufted, dark green; stems erect or ascending, tomentose at base, simple or forked, 3–9 inches high. Upper leaves spreading, loosely incumbent when dry, similar in form to those of *P. gracile*, but *larger, 5–7 lines long*, margin erect, sharply serrate, *very narrow, of 2–3 rows of smaller cells*, about 10–12 μ in diameter, cells of leaf-base longer and narrower than in *P. gracile*, very narrow at margin, in middle of wing towards nerve about *6–10 times as long as broad;* lamellae *about 60 70*, very low, in section of 3–5 cells, *smooth, equal, rounded*, or the marginal one very slightly larger and a little longer than broad. Perichaetial bracts with long sheaths, longly acuminate. Seta stout, long, 2–2½ inches, rigid, orange below, paler above. Capsule covered by the calyptra, erect or inclined, cernuous when dry, *oblong, with 5 or 6 (rarely 4) acute angles*, yellow-green, fawn-coloured when ripe with a small but *distinct apophysis*, constricted above where it joins the capsule; lid large, with a *rather long beak; mouth of the capsule wide*, not contracted. Cells of exothecium turgidly mamillose, but without papillae. Spores 10–14 μ.

HAB. Dry woods. Common. Fr. summer.

A taller plant than the last, intermediate in habit between the last species and *P. commune*, with a longer, narrower capsule than in either. It is frequently confused with *P. commune*. It usually has the leaves more crowded, and less squarrose when moist, and the beak of the lid longer; but the most certain character is to be found in the lamellae of the leaves, which in the present species have the marginal cell smooth and rounded or oval (in section),

while that of *P. commune* is broad, depressed in the centre and bifid. The perichaetial bracts are also more distinct in that species. *P. ohioense* R. & C. is a closely allied species from N. America, differing chiefly in the apical cell of the lamellae in section more or less flattened, wider than long. The var. *pallidisetum* B. & S. appears to be nothing more than a form with shorter stems and narrower, somewhat elongated capsule.

10. Polytrichum commune L. (Tab. VII. A.).

Plants *very tall*, 6–18 inches high, in large, loose cushions, deep green, tomentose at the base; stems simple, rarely forked, flexuose and wiry. Upper leaves very long, *squarrose or recurved* when moist, erect when dry and appressed, with the apex flexuose; rather laxly arranged, very long, from an oblong sheathing base suddenly narrowed, limb lanceolate, gradually narrowing from its base upwards, to a sharp dentate acumen; margin densely and sharply serrate to the base of limb, *very narrow, of about one row of small cells*, similar to those of *P. formosum*, as are also those of the leaf-base; lamellae *about 60*, low, thickened at the upper border and channelled, appearing in section of 4–6 cells, *the marginal one broader, depressed in the centre and bicuspidate*. Perichaetial bracts more distinct, longly sheathing, membranous, without lamellae, ending in an arista formed by the excurrent nerve. Seta very long, 2½–4 inches, stout. Calyptra descending below the capsule, large, golden brown. Capsule at first erect, pale reddish brown when ripe, and horizontal, *four-angled*, with the two lateral angles usually larger and more prominent than the upper and lower, so that the capsule is somewhat flattened; in outline *shortly rectangular or almost cubic;* apophysis discoid, *very distinct* and narrowly constricted at its junction with the capsule; lid with a *short* rostellate beak. Cells of exothecium each with a high, conical papilla, bearing a small, narrowly-elliptical or slit-shaped pore at the apex. Male plants shorter, with shorter leaves, repeatedly proliferous from the centre of the perigonia.

Var. *β. perigoniale* B. & S. (*P. perigoniale* Michx.). More densely tufted, with shorter stems; *inner perichaetial leaves very long*, with an elongated, *almost entire* arista. Lamellae higher, of 6–9 cells; marginal cell scarcely broader than the rest, *only slightly depressed* in the centre. Apical pore of papillae of capsule *rounded* or narrowly elliptical.

Var. *γ. minus* Weis (vars. *minus* and *fastigiatum*, Braithw. Br. M. Fl.). *More slender*, simple or fastigiately branched; capsule *smaller and shorter, almost cubical;* lid with a short straight beak. Marginal cell of lamellae *but little depressed* in the centre. Lamellae of 6–9 cells in height.

Hab. Marshy moors and peat bogs. Common. The vars. *β*, *γ*, in drier spots, less frequent.

Superficially, *P. commune* much resembles *P. juniperinum*, the varieties especially, but the serrated leaf margin will reveal its identity, even without the aid of a lens. Its difference from the preceding species is much less marked, but the more shortly rectangular, more distinctly apophysate, papillose capsule will generally identify it, and in any case the form of the marginal cells of the lamellae will always prove a reliable character.

The var. *minus* in its unbranched, slender state, is an analogous form to the sub-species *strictum* of *P. juniperinum*. The var. *fastigiatum* would seem only to be a branched state of this variety.

The varieties *perigoniale* and *minus* run very near to one another. Limpricht, indeed, gives the former specific rank, distinguishing it from *P. commune* by the form of the perichaetial bracts, the degree of roughness at the back of the leaf, the size of the exothecium cells, etc. I have, however, found almost all these characters variable, and I greatly doubt whether the two should not be merged together into one variety. The one character in var. *perigoniale* that seems to possess some importance, is the form of the apical pores of the papillae of the capsule wall; these are described by Limpricht as rounded (not slit-shaped or narrowly elliptical), and this character may possibly have some weight. On the other hand, the narrow slit-shaped pore is sometimes associated with well-marked perichaetial bracts, as in specimens from Strensall Common, York, in Wilson's herbarium, labelled by him var. *minus*; whereas, according to Limpricht, the perichaetial bracts in var. *minus* are scarcely different from the upper leaves. (Since the above was in print, Limpricht's Supplement, p. 802, has been issued, correcting the description of *P. perigoniale* in one or two points, and still further diminishing its difference from the var. *minus*; notably by the admission that the apical pores in the exothecium may be narrowly elliptical as in that variety).

P. commune is one of the most highly developed and perhaps the finest of our mosses; it is one of the few species that is put to some practical use, being collected in Lapland for pillows and beds, both by the Lapps themselves and, according to Withering, by the bears. In this country it is occasionally used for stuffing mattresses and for brooms.

Order V. BUXBAUMIACEAE.

Plants very small, almost or quite stemless, growing on earth or rotten wood. Capsule very large in proportion to the size of the plant, oblique and asymmetrical. Calyptra very small, conical; peristome single or double, the outer teeth when present originating in several concentric layers of cells, linear, very faintly barred; the inner a conical plicate membrane with an opening at the top.

A very remarkable Order of mosses, consisting of half-a-dozen species presenting a quaint appearance unlike that of any others of the class, and no less striking in their morphological characters. It is clear from the researches of Lindberg, Philibert, and other bryologists that most of the present types of peristome must have become fixed before the differentiation of the vegetative organs (*e.g.*, the Hypneae, Bryaceae and Mniaceae must have had a common parentage from which they derive their uniform type of peristome). In other words, it seems that the evolution of the Sporogonium was prior to that of the Oogonium, and mosses must have originally consisted of a protonema with a highly organised sporogonium, but with very little development of stem or leaves, the ordinary leaves having been produced later in order of time and very

possibly having arisen by modification of the perichaetial bracts. Thus, not only in type of peristome, but also in the general habit and morphology, we may probably look upon this Order, and especially the genus Buxbaumia, as an archaic type which has survived in something like its primeval form. Even in Diphyscium, the true leaves, though perfectly developed, are quite an inconspicuous part of the plant beside the fruit and perichaetial bracts.

I have retained the union of the two genera under this Order, which is, perhaps, the most usual arrangement, partly on account of the general resemblance of the capsule and its internal structure, and partly on account of the great similarity of the peristomes, a marked and real similarity, though perhaps less so than would appear at first sight. The form and structure of the leaf in Diphyscium is hardly, I think, sufficient in itself to outweigh these important affinities and justify its separation from Buxbaumia.

The presence of delicate articulations in the outer teeth, and the minute structure of these and the inner peristome (as pointed out by Philibert, *Rev. Bry.*, 1889, pp. 4, sqq.), indicate an approach on the part of the Buxbaumiaceæ to the Arthrodonteæ, but the origin of the outer teeth in several series of concentric cell-layers constitutes a sufficient ground for placing the Order among the Nematodonteæ, though at the end of the series.

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7. **BUXBAUMIA** Haller.

Plants very minute, scattered, *stemless*. Leaves indistinguishable from the perichaetial bracts, all *minute*, ovate or lanceolate, palmate with ciliar productions of the marginal cells, nerveless, without chlorophyll. Male plant (v. Goebel, in *Flora*, 1892, Suppl. pp. 92, sqq.) among the vaginular tomentum, a concave, shell-like leaf, enclosing a single globose stalked antheridium, similar to that of the Hepaticæ. Mature fruit on a *stout rough seta, large*, somewhat obliquely egg-shaped, with the narrow end pointed and slightly recurved, *inserted obliquely on the seta* with a short neck, flattened on the upper surface, brown. Outer peristome of *one or several rows of irregular filiform teeth*, inner a pale tubular membrane in the form of a truncated cone, longitudinally plaited like the folds of a fan, with 32 plicæ. Dioicous.

Deriv.—After Buxbaum, a German botanist.

{Capsule plano-convex, much flattened above, glossy.....*1. aphylla*
{Capsule scarcely flattened, paler, epidermis splitting when dry...*2. indusiata*

1. **Buxbaumia aphylla** L. (Tab. VII. B.).

Plants very small, growing on a thick stratum of brownish protonema. Bracts minute, almost obsolete, brownish, the

marginal cilia developing, after fertilisation, into protonemoid filaments, so that when the capsule is mature little is to be seen around the thickened vaginula but a mass of rufous tomentum. Seta thick, very scabrous, about half-an-inch long, purplish. Calyptra minute, conico-cylindrical, usually split on one side. Capsule inclined or almost horizontal, with a stout, distinct neck, *depressed above and with a more or less angular border*, broadly ovate-acuminate in outline; of a dark brown colour and thick texture, *glossy*, the cuticle rolling back from the mouth at maturity and forming a border; lid short, obtusely conical, more or less erect and recurved, attached to the columella. Peristome, the outer *a single series* of very short, filiform, papillose teeth hardly rising above the surrounding membrane; inner membrane pale brown, papillose. Spores very small, *about 5 μ* in diameter.

HAB. On the ground or on rotten wood, especially in fir woods; not often re-appearing twice in the same locality. Rare. Fr. spring and early summer.

This very strange plant was formerly considered a fungus, and indeed to any but a bryologist it seems to have little in common with other mosses. The fruit is as large as that of Polytrichum, and seems disproportionate to the size of the plant. Goebel, in the paper above quoted, has shown that what has usually been taken for the *antheridium* is really the male *plant*, enclosing a single globose, stalked antheridium similar to that of Sphagnum and of the Hepaticae; and he points out, too, the primitive character of the leaves or perichaetial bracts, which are very little more than expansions of the protonema normally producing new protonemoid threads at their margins, as might take place at any other part of that organ.

2. Buxbaumia indusiata Brid. (Tab. VII. C.).

Capsule on a *shorter, less scabrous seta*, more erect, *less flattened above*, narrowly oval, paler, *not glossy;* cuticle thinner, splitting longitudinally at maturity with the edges rolled backwards; lid rather larger; outer peristome of *four* concentric rows of linear teeth, the outermost very short, the inner gradually longer, *the innermost more than half the length of the inner peristome;* all more or less finely articulate, papillose, brownish; spores larger, *about 10 μ.*

HAB. Decayed branches in pine woods. Fr. summer. Very rare. Aberdeenshire, Ross-shire.

Rather smaller and of a less rigid habit and texture, and a paler colour.

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8. DIPHYSCIUM Mohr.

Plants very short, gregarious. Leaves *lingulate or lanceolate*, fragile, *of 2-3 layers of rounded cells, nerved*. Perichaetial bracts *large*, membranous, *laciniate above*. Capsule immersed or exserted, almost sessile, oval-acuminate, *oblique*, gibbous, narrowing upwards to the somewhat recurved lid. Calyptra conical,

entire, minute, fugacious; outer peristome *none or rudimentary*, inner a pale membrane, exactly as in Buxbaumia, but with only 16 plicae. Spores minute. Dioicous.

DERIV.—δι-(di) two, and φυσκη-(physcē) a bladder; alluding to the double tissue of the exothecium and sporangium, which are very distinct in this genus.

1. **Diphyscium foliosum** Mohr (*Webera sessilis* Lindb., Braithw. Br. M. Fl.; *Mollia Haggarti* Stirt. in Ann. Scot. Nat. Hist. xi, 106) (Tab. VII. D.).

Plants densely gregarious, dark or brownish green. *Stems short; leaves narrowly lingulate*, variously pointed, *obtuse and cucullate*, or shortly and bluntly acuminate, *crisped when dry*, fragile; margin plane, crenulate-papillose in the upper part and also at times sinuose or slightly dentate towards apex; nerve vanishing below the apex, *broad* and flattened, especially at base, often indistinct. Areolation rounded-quadrate in the upper part of the leaf, *strongly papillose on both sides*, of 2 or more layers of cells, *obscure*; gradually becoming more rectangular and less obscure below, smooth; towards the base hyaline, rectangular, at margin very thin. *Perichaetial bracts very large*, the outer resembling the leaves but gradually narrowed from a broader base to a long setaceous point composed of the excurrent nerve, the inner broader, ovate-lanceolate, membranous at margin and white, almost without chlorophyll, at apex lacerate with denticulate cilia, and longly aristate with the excurrent nerve, forming a brown, denticulate hair almost as long as the limb of the bract; nerve very broad, golden brown. *Capsule almost sessile*, hidden by, or slightly emergent from the perichaetial leaves, about the size and with somewhat the aspect of a grain of wheat, golden brown when ripe, asymmetrical, with a curved apex formed by the conical, acute lid; inner peristome white at the fall of the lid, becoming brown with age. Male plants scattered, minute; inner bracts ovate, concave, with excurrent nerve.

Var. β. *acutifolium* Lindb. Stems *taller;* leaves longer, *more acuminate and acute.*

HAB. Turfy banks and clefts of rocks in subalpine and mountainous regions, frequent. Fr. summer. The var. β less common, usually barren.

The quaint appearance of the capsule, surrounded with the large, scarious perichaetial bracts, is totally different from that of any other of our mosses, and when once seen cannot be again mistaken. It is, however, very different with barren plants, which may easily be overlooked, or mistaken, even on closer examination, for a species of Trichostomum, *e.g.*, *Tr. nitidum* or *Tr. tenuirostre*. This, indeed, has often been done, and the var. *acutifolium* was recently described as a new species under the name of *Didymodon Camusi* by Husnot (v. *Muscol. Gall.*, pp. 80, 433). It may, however, be recognised by the 2-3 layers of cells in the leaf, and by the broad, ill-defined vanishing nerve, taken

in conjunction with the broad, hardly acute apex of the leaves, which are not very strongly crisped and hardly shining when dry.

The var. *acutifolium* graduates into the type by intermediate forms, but in its extreme state, as I have found it freely in the Lake District, with tall, somewhat branched stems and very long, narrow leaves, it is a well-marked form. Dr. Braithwaite describes it as having the arista of the perichaetial bracts smooth, but I have not found them noticeably different from those of the type.

Schimper describes the outer, rudimentary teeth of the peristome of *Diphyscium foliosum* as "very short, triangular, granulose, transversely jointed, not unfrequently perforated in the middle, pale yellow, reddish purple at apex." Hardly any other bryologist appears to have been able to detect them so far developed at least as to render any such detailed description possible.

GROUP B. ARTHRODONTEAE.

Peristome teeth (when present), thin, membranous, derived from a single layer of cells of the sporogonium; transversely barred.

DERIV.—From *ἀρθρο-*(arthro) jointed, and *ὀδοντ-*(odont) tooth.

SUB-GROUP I. APLOLEPIDEAE.

Peristome teeth often forked above, at base composed of two layers of plates; in the outer layer a single plate forms the width of the tooth; in the inner two plates go to form the width of the tooth, which therefore, when viewed from the *interior*, presents a fine dividing line down the centre; the front, or exterior, surface, on the other hand, being without this division. In some genera, as Barbula, the teeth are divided to the base, so that the above structure cannot be traced.

Acrocarpous mosses, with rare exceptions; *i.e.*, the perichaetium is apical, forming a continuation of an ordinary stem or branch, which may, however, appear lateral by *subsequent* innovation below the perichaetium.

DERIV.—From *ἁπλο-*(haplo) single, and *λεπιδ-*(lepid) a scale or plate, referring to the single plate forming the outer layer of the tooth.

ORDER VI. DICRANACEAE.

Plants variable in size, dichotomously branched. Leaves narrow, from subulate to broadly lanceolate, rarely ovate-oblong, nerved nearly or quite to apex, areolation never wide, small, above more or less quadrate, rectangular or linear, at base rectangular, often with special alar cells. In a very few cases the capsule

is more or less spherical, and cleistocarpous, with irregularly torn calyptra; in all the other species the calyptra is smooth, narrow, cucullate, very rarely mitriform; capsule on an elongated seta, narrow, oval to cylindrical, frequently cernuous and gibbous; peristome of 16 teeth, usually cleft above, sometimes to base, into two lanceolate or subulate divisions, transversely articulated, with fine vertical striæ between the articulations, occasionally imperfect, usually reddish, the *interior* plates usually thickest, often transversely trabeculate.

The typical form of peristome teeth in this Order, as shown on Tab. XIV. C., broad at the base and transversely barred, forked above, is frequently termed *dicranoid*.

This constitutes a fairly natural family, though on one side bordering closely on the Tortulaceae; one or two of the genera, as Ditrichum, might well, indeed, judged by the characters of their fruit alone, be placed under that Order, but the general habit and leaf-form is that of Dicranaceae; indeed in every case in this Order where the form of the fruit or the structure of the peristome might appear to connect a species with the Tortulaceae its true position will be rendered apparent either by the lid being longly subulate or by the leaves being narrow and linear-lanceolate or subulate, with narrow rectangular areolation. The cleistocarpous species of this Order are recognisable by the leaf-cells in the upper part being small and narrow, and smooth, not papillose.

The student will at first, no doubt, have some difficulty in referring some ambiguous species of both Tortulaceae and Dicranaceae to their right Order, but the difficulty will soon disappear when a little practical acquaintance has been gained with the plants themselves.

As many as 600 species have been described. The British members of the Order may be classified under seven Tribes, which, for the sake of convenience, are tabulated here.

1. *Ditricheae*. Leaves lanceolate or lanceolate-subulate, almost always smooth, without distinct angular cells. Capsule rounded, cleistocarpous; or ovate to cylindrical, either erect and symmetrical or slightly inclined and unequal, smooth; lid conical; peristome teeth 16, very narrow, forked or cleft to base into 32 filiform divisions.

2. *Seligerieae*. Plants minute. Leaves lanceolate-subulate, smooth, without distinct angular cells (in the British species). Peristome of 16 short teeth, cleft or perforated, or entire, sometimes wanting. Capsule erect or nearly so, symmetrical, smooth or very slightly and irregularly striate. Lid rostellate or shortly subulate-rostrate.

3. *Cynodontieae*. Leaves chlorophyllose, often rather broadly lanceolate, usually papillose, without distinct angular cells, the

upper small, more or less quadrate. Capsule on a long seta, oblong or oblong-cylindrical, usually inclined or curved, frequently strumose, and mostly striate. Peristome variable.

4. *Trematodonteae*. Stems short. Leaves lanceolate-subulate, without distinct angular cells. Capsule with a long inflated neck, which is sometimes longer than the capsule itself; cleistocarpous in the continental genus Bruchia; in Trematodon, the only British genus, peristomate, with 16 lanceolate, perforated or cleft teeth.

5. *Dicranelleae*. Plants mostly small, scarcely branched. Leaves smooth, nearly always lanceolate-subulate, without special angular cells. Capsule short, erect or inclined, frequently striate; lid rostellate or subulate-rostrate; peristome dicranoid, of 16 cleft teeth, wider at base.

6. *Dicraneae*. Plants usually tall, branched. Leaves narrowly lanceolate, often falcato-secund; cells at angles enlarged, often inflated, hyaline or coloured. Peristome variable. Lid almost always longly subulate.

7. *Leucobryeae*. Plants whitish, the leaves almost without chlorophyll, almost entirely composed of the nerve; internal walls of the cells porose. Capsule as in Dicranum; peristome of 8 or 16 teeth, dicranoid.

Tribe 1. Ditricheae.

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9. **ARCHIDIUM** Brid.

Plants small, branched by innovations below the apex. Leaves ovate-lanceolate, areolation narrowly hexagono-rhomboid. *Capsule sessile, spherical, cleistocarpous*, formed of a single layer of cells without columella or true spore-sac, the spores being produced from a single basal cell, the contents of which by repeated division form *about 16 large*, smooth spores. Calyptra very thin, *saccate, tearing irregularly*.

DERIV.—ἀρχιδιον (archidion), primitive.

1. Archidium alternifolium Schp. (*Phascum alternifolium* Dicks., *A. phascoides* Brid.; *Pohlia tenerrima* Stirt. in Ann. Scot. Nat. Hist. xvii, 174) (Tab. VII. E.).

Plants minute, in dull green patches, stellately branched, the innovations formed below the apical inflorescence, elongated and finally prostrate, with small-leaved ramuli. Leaves distant, minute, erecto-patent, slightly twisted when dry, lanceolate from a broader base, the upper lanceolate-subulate, margin sinuosely denticulate, more distinctly so at apex; nerve narrow, vanishing in the apex or percurrent. Areolation smooth, rhomboid or

rectangular and parenchymatous, or longer, narrowly hexagonal and prosenchymatous, wider at base. Perichaetial bracts longer, from a broader concave base, denticulate at apex, forming a comal tuft. Capsule terminal, finally lateral by innovation, immersed, pale yellow. Spores very large, obtusely angled. Antheridia among the perichaetial leaves, with few small bracts.

HAB. Wet fields and bare spaces; not common. Fr. spring.

Varying somewhat in size and habit, and in the form and size of the leaf and of the areolation, this curious little moss has an appearance of its own which is hardly like that of any other, even in the barren state; its resemblance is greatest with *Pleuridium alternifolium*, but the leaves in that, especially the perichaetial bracts, are much longer, with a much broader nerve, and smaller cells. In *Pleuridium axillare* the cells are larger and the leaves longer. The fruit, moreover, which is quite distinct in form in the two genera, is usually present in Pleuridium. It is much less frequent in Archidium, and the sterile plant frequently consists almost entirely of the small-leaved flagelliform branches.

This genus is by Schimper and other authors placed in a separate Order, on account of the peculiar structure of the sporogonium. While, however, in this respect it obviously retains the characters of a primitive form, its vegetative characters so closely resemble those of the next genus as to justify their being placed in close proximity, an arrangement which is also of much greater convenience to the student.

In the shorter, lower leaves and those on the flagelliform branches, the areolation is usually short and parenchymatous, either rectangular or becoming rhomboidal by the obliquity of the end walls; at other times, and especially in the elongated perichaetial bracts, it becomes much narrower, elongated and sinuose, often distinctly hexagonal-rhomboid and prosenchymatous.

The present is the only European species, but there are several closely allied species in N. America.

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10. **PLEURIDIUM** Brid.

Minute, *cleistocarpous* mosses. Leaves lanceolate or lanceolate-subulate, smooth. *Capsule erect, on a very short seta, immersed in the perichaetial leaves, ovate-globose with a short point.* Calyptra small, *cucullate*. Spores rather large, granulose.

DERIV.—πλευριδιον (pleuridion) on one side; alluding to the capsule being (occasionally and apparently) lateral.

1 { Perichaetial leaves similar to the rest; nerve ceasing below apex ..... *1. axillare*
  { Perichaetial leaves much longer than the rest; nerve reaching apex...2

2 { Perichaetial leaves gradually subulate-setaceous, enclosing naked antheridia ..... *2. subulatum*
  { Perichaetial leaves suddenly contracted; male flowers gemmiform, axillary ..... *3. alternifolium*

1. Pleuridium axillare Lindb. (*Phascum axillare* Dicks.; *Pleuridium nitidum* Rabenh., Schp. Syn.) (Tab. VII. F.).

Plants small, loosely clustered, pale green. Stems about ¾-inch high, simple or slightly branched. Leaves patent, slightly

twisted when dry, lanceolate or linear-lanceolate, short at base of stem, gradually longer upwards, *perichaetial bracts similar to the upper leaves; nerve thin, vanishing below the apex*, margin plane, faintly serrulate at apex; cells *rather large, lax*, pellucid, rectangular-rhomboid below, narrowly linear or elongate-rhomboid above. Capsule on a very short seta, oval, shortly pointed, pale brown, calyptra covering only the upper half of the capsule. *Antheridia naked among the perichaetial bracts.*

Var. β. *strictum* Braith. (*Phascum strictum* Dicks.). Plants *very small*, dull green; *leaves and bracts closer, narrower, straight*; capsule *nearly spherical.*

HAB. Fallow fields and sides of pools; not uncommon. The var. β, Scotland. Fr. winter.

This species is known from the others of the genus by its paler colour, the more delicate and less rigid habit, by its leaves and perichaetial bracts being alike, and by its larger cells. It is, indeed, more like *Archidium alternifolium*, although quite distinct in the fruit. The stem innovates below the capsule (which thus becomes lateral), producing another fruit at its apex, and repeating the same process several times, so that two or three capsules may be found on the same stem, one above the other.

2. Pleuridium subulatum Rabenh. (*Phascum subulatum* Huds.) (Tab. VII. G.).

Stems short, simple, rarely branched or innovated, crowded, dusky or yellowish green. Leaves small, lanceolate or ovate-lanceolate, longer above; perichaetial bracts erect or subsecund, straight when dry, from a small oval base *gradually subulate and setaceous, very long*; nerve broad and ill-defined, continuous to apex; *margin minutely denticulate*, occasionally entire; cells at base rectangular or hexagonal-rectangular, above forming a very narrow margin to the subula with narrower cells, sometimes becoming extremely slender and elongated, so as to be almost indistinguishable from the nerve. Capsule yellowish brown or reddish, oval or roundish-oval, with a short obtuse point. *Antheridia naked in the axils of the perichaetial bracts.*

HAB. Sandy heaths and banks. Common. Fr. April to June.

The more rigid habit and the long setaceous perichaetial bracts will readily distinguish this species from the last; but it is much more difficult to define the differences between it and *P. alternifolium*, except in regard to the position and form of the male inflorescence, which in the latter is easily visible in the axils of the upper leaves when a fruiting stem is placed under a low power of the microscope, but which in the present plant is only seen after dissection. The subula of the perichaetial bracts is in the present species more remotely and indistinctly denticulate, sometimes quite entire; while in that the denticulations, though minute, are more crowded and numerous and consequently more conspicuous, and the cells are smaller. The apical innovations also, which are common though by no means constant in that species, are rarely present in our plant.

It is the commonest species of the three, and is usually rendered more conspicuous by the numerous capsules than by the appearance of the rest of the plant. The species of this genus are not likely to be mistaken for any others except *Archidium alternifolium*; the cleistocarpous species of Weisia, perhaps, most nearly resemble them, but are directly recognised by the upper leaves strongly curled when dry, and the minute, papillose areolation of the leaf apex.

3. Pleuridium alternifolium Rabenh. (*Phascum alternifolium* Kaulf.) (Tab. VIII. A.).

Densely tufted, stems short, simple; yellowish green; in damp or shady spots the stems are frequently elongated, as much as an inch high, with long flagelliform innovations, and of a bright green. Leaves ovate-lanceolate and lanceolate, nerve vanishing in apex; perichaetial bracts *very long*, silky, straight when dry, *rather abruptly narrowed* from an oval base to a long setaceous point, the upper part entirely composed of the excurrent nerve, *finely and closely denticulate and muricate*; nerve broad and ill-defined below; cells at base rectangular and rhomboid, above rectangular, *smaller than in the last two species*. Capsule oval, with a rather longer apiculus. Male flowers *gemmiform*, numerous, *in the axils of the upper leaves*, bracts ovate, acuminate.

HAB. Wet places, borders of fields, etc.; not very common. Fr. spring and summer.

A less frequent species than the last with us, though it is the most common of the genus on the Continent. The perichaetial bracts are still longer than in the last species.

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11. DITRICHUM Timm.

Plants tufted, slender. *Leaves in several rows*, lanceolate-subulate, smooth, very rarely papillose; areolation rectangular, narrow above. *Capsule* on a long slender seta, erect or slightly inclined, *oval, oblong-cylindrical, or cylindrical*, annulate. Peristome teeth erect, 16, not confluent below, elongate, cleft to base into two *filiform*, papillose, articulate divisions, which are sometimes more or less united above; on a short basal membrane. Spores very small, smooth.

A genus clearly marked off by the peristome taken in conjunction with the subulate leaves. The name Leptotrichum, which has usually been employed, has been shown by Hampe to be untenable, having previously been taken up for a genus of fungi.

Loeske (*Bryologische Zeitschrift*, I., 6, sqq.) has shown that the relationships of *D. vaginans* and *D. zonatum* have been misunderstood; the former having much closer affinity to *D. homomallum* than to *D. tortile*. I have modified the arrangement in accordance with this view.

DERIV.—δι-(di) two, and τριχο-(tricho) hair, from the divided, filiform peristome teeth.

1 { Ls. squarrose, suddenly contracted from a broad sheathing base *1. tenuifolium*
  { Ls. erecto-patent or secund 2
2 { Stem tall, flexuose ; ls. usually very long ; cells shortly oval... *5. flexicaule*
  { Stem short, straight ; ls. short ; cells linear or rectangular 3
3 { Ls. abruptly long setaceous, flexuose ; paroicous..... *4. subulatum*
  { Ls. shorter, gradually narrowed ; dioicous..... 4
4 { Margin recurved 5
  { Margin plane 6
5 { Ls. longish, denticulate, only slightly concave above..... *2. tortile*
  { Ls. very short, almost entire, channelled at point..... *3*. vaginans*
6 { Stems short, ls. rather long ; upper cells long..... *3. homomallum*
  { Stems long, ls. very short ; upper cells rather short..... *3*. zonatum*

1. Ditrichum tenuifolium Lindb. (*Trichostomum tenuifolium* Schrad. ; *Trichodon cylindricus* Schp. Syn.) (Tab. VIII. B.).

In yellowish green tufts, or gregarious ; stems short, usually simple. Rootlets sometimes producing small brown tubercular swellings underground. Leaves flexuose, *squarrose from an oblong sheathing base, suddenly narrowed* to a fine, almost setaceous subula, the greater part formed of the nerve, *irregularly and closely denticulate and rough* with the projecting transverse walls of the cells ; *margin plane ;* areolation at base *narrowly rectangular, long,* almost hyaline ; shorter above, in the subula irregularly quadrate, hardly distinct from the cells of the nerve, obscure. Seta pale red, long ; capsule erect or slightly inclined, straight or faintly curved, *narrowly cylindric,* smooth ; lid obtusely conical ; annulus broad, of two or three rows of cells ; peristome teeth pale red, papillose, the divisions occasionally slightly united towards the base. *Dioicous.* Male plants more slender, in separate tufts, bracts subulate, concave.

HAB. Sandy ground in wet places, rare, but easily overlooked. Fr. summer, but rarely fertile.

A very small and inconspicuous plant in the sterile state, and undoubtedly often passed over. The structure of the peristome, having the divisions of the teeth occasionally united a little above the base, and the broader annulus of several rows of cells, are somewhat characteristic of the genus Ceratodon ; but the form of the leaves and the smooth cylindrical capsule seem to justify its inclusion in the present genus ; the squarrose leaves, suddenly narrowed from the broad sheathing base and very rough in the upper part will serve to separate it from the others of the genus ; and its general appearance is indeed more that of *Dicranella Grevilleana, D. crispa,* and *D. Schreberi,* to which in fact it bears a close resemblance in the leaves ; in the two former, however, the leaves are entire or nearly so, and in the latter the subula, though frequently toothed above, is usually so on the margin alone, not nodulose and papillose all round as in the plant under consideration, nor are the cells in the upper part so obscure. However, the plants in the barren state can often be separated only by very careful examination.

D. subulatum has the leaves erecto-patent when moist, and the subula only faintly denticulate.

2. Ditrichum tortile Lindb. (*Trichostomum tortile* Schrad.; *Leptotrichum tortile* Hampe, Schp. Syn.) (Tab. VIII. C.).

Tufted, dull green, not glossy, stems simple or nearly so, short. *Leaves short, patent or turned to one side*, slightly curved, *gradually narrowed* from a narrowly ovate or oval-triangular base to a lanceolate-subulate, slightly concave point; margin slightly thickened, *recurved* from a little above the base to near the apex, *denticulate* above; nerve slightly excurrent, toothed at apex, clearly defined throughout; areolation *hexagonal-rectangular* at base, chlorophyllose, irregularly rhomboid or quadrate above; in upper part of leaf in two layers towards margin. Perichaetial bracts resembling the leaves, but longer, half-sheathing. Seta red. Capsule erect, *narrowly or oblong-cylindrical, pale brown;* annulus broad, of a single row of cells; lid longer than in the last, conical-rostellate. Peristome teeth red, the divisions here and there united. *Dioicous;* male plants short, bracts ovate-subulate.

Var. *β. pusillum* B. & S. (*Trichostomum pusillum* Hedw.). Stems more densely crowded, shorter. *Leaves shorter, broader;* capsule *oval or oblong*, peristome shorter. Perichaetial bracts with a shorter point, more distant and more sheathing.

Hab. Sandy banks and quarries, rare. Yorkshire, Sussex, Kent. The var. *β* in similar habitats, sometimes with the type; Ireland, Yorkshire, Wales, Scotland. Fr. winter.

This species is very variable in the form and size of the capsules; I have seen them on the same tuft from cylindrical to very shortly ovate, indeed (without the lid) hardly longer than broad; the var. *β* cannot therefore be considered a clearly defined form. The leaves are shorter than in *D. homomallum* and *D. subulatum*, with the upper cells wider and shorter, and are also more denticulate, wider in the middle, with the margin recurved. It also varies in the length of the leaves; these are sometimes very short, and in proportion to their size, broad, with the lamina distinct to the apex; especially in some forms of the var. *pusillum*.

3. Ditrichum homomallum Hampe (*Didymodon homomallus* Hedw.; *Leptotrichum homomallum* Hampe, Schp. Syn.) (Tab. VIII. E.).

Plants loosely tufted, somewhat silky, pale or yellowish green, short, stem simple or nearly so, ½–1 inch high. Leaves glossy, subsecund, from an oval or narrowly triangular base, *gradually lanceolate-subulate; margin plane;* nerve broad, *rather undefined*, often *filling the greater part of the subula*, and excurrent, with a few minute denticulations at apex; *areolation very narrow*, linear or rectangular, firm, *not much shorter above*, chlorophyllose. Perichaetial bracts longer, sheathing. Seta straight, purple. Capsule *ovate-oblong or oblong, pachydermous, darker* than in *D. tortile*, reddish, shining, somewhat narrowed at mouth; lid conical or conical-rostellate, obtuse. Annulus of two

rows of cells. Peristome purplish, the basal membrane indistinct, teeth with the divisions free or united. *Dioicous;* male plants slender; bracts lanceolate-subulate.

HAB. Sandy banks and crevices of subalpine rocks, frequent. Fr. autumn.

The commonest species, *D. flexicaule* excepted, and usually fruiting. The plane-margined smooth leaves with narrow and elongated areolation perhaps afford the most obvious characters, distinguishing it from the two preceding species; the habit and longer leaves from *D. zonatum*. From *D. subulatum* it differs essentially in the inflorescence. The peristome, as is usual in this genus, is very fragile.

*** Ditrichum zonatum** Limpr. (*Weisia zonata* Funck; *D. homomallum* var. *zonatum* Lindb., Handb. Ed. 1; *Leptotrichum confertum* Stirt. in Ann. Scot. Nat. Hist. xv, 112; *Conostomum* (?) *extenuatum* Stirt., op. cit., xi, 112) (Tab. VIII. F.).

In *dense neat* tufts, *very compact*, 1–2 inches high; dark or golden green above, pale or dark brown within. Stems very slender, fragile, slightly branched. Leaves *erect, rigid, short*, gradually shortly acuminate from an ovate base, *deeply channelled above*, entire or with one or two minute teeth at apex; margin *plane*. Nerve stout, ill defined, scarcely excurrent, lamina continued to apex but of 2 3 layers of cells, and therefore ill defined from the nerve. Cells *shorter* than in *D. homomallum*, variously and irregularly rectangular to sub-quadrate above. Dioicous. Seta yellowish. Fruit has only once been found, on the Brocken.

Var. *β. scabrifolium* Dixon (Journ. of Bot. 1902, p. 378). In looser tufts; leaves *usually longer*, with a longer subula, *more spreading and flexuose*. Upper cells and occasionally the lower almost to base *scabrous with large conical papillae*, frequently on both sides of lamina and back of nerve.

HAB. Clefts of rocks on high mountains, rare. Var. *β* rare; Scotland; N. Wales; Brecon; Lake District.

The position of this plant must remain somewhat doubtful, but I have accepted Limpricht's view in raising it above varietal rank; the general sum of characters distinguishing it from *D. homomallum* being indeed not inconsiderable in a genus where the vegetative features show on the whole but slight variation. The interior of the tufts is prettily belted with varying shades of colour corresponding to different years' growths, whence the specific name. The plane margin will separate it easily from *D. vaginans*.

The var. *scabrifolium* is a very remarkable one, departing so widely as it does in the papillose cells from what is otherwise the almost universal rule in this genus. *D. tenuifolium* has indeed the subula scabrous, but this is due to projections on the nerve, not to papillae on the cells of the lamina. I have also observed a very light papillosity in leaves of *D. Drummondi* Ferg. (which must I think be referred to *D. flexicaule* var. *densum*), but only to a very slight

extent. On the other hand I have forms of *D. zonatum* from several localities exhibiting a slight papillosity, not sufficient to justify their being placed in the variety, but clearly affording a link between it and typical *D. zonatum*. The leaves are in most of the specimens longer and more flexuose than in the type, but this is not the case with the Ben Lomond plant.

Catoscopium nigritum bears a not inconsiderable resemblance to *D. zonatum*; it is, however, as a rule found fruiting; moreover it is usually of a paler green, with more flexuose leaves, and with the stems densely tomentose; in the present plant the stems are almost entirely without radicles.

* **Ditrichum vaginans** Hampe (*Trichostomum vaginans* Sull.; *Leptotrichum vaginans* Schp. Syn., excl. var. *β*) (Tab. VIII. D.).

In somewhat *dense* tufts, yellowish green or golden, slightly glossy. Stems about half-an-inch high, with *numerous straight erect fragile sterile branchlets, terete, with short, closely imbricated leaves*. Leaves close, *erect, appressed when dry*, from an ovate base narrowed to a longer or shorter *concave, almost tubular* point, entire or very faintly denticulate at apex; margin *narrowly recurved*, usually on one side only. Areolation as in *D. tortile*. Nerve more clearly defined. Perichaetial bracts more distinct, *sheathing*, with short points. Seta yellowish. Basal membrane of peristome teeth shorter, scarcely projecting above the mouth of the capsule.

Hab. Sandy and peaty ground on mountains. Very rare. Discovered by Mr. J. H. Davies near the summit of Colin Mt., Co. Antrim, 1901; Ben Nevis. Sterile.

Readily distinguished from *D. tortile* by the straight, terete, rigid, dense-leaved branches, and the entire leaves, deeply channelled above; from *D. homomallum* and *D. zonatum*, which it otherwise closely resembles, by the recurved margin of the leaves. According to Loeske the margin is not always recurved, while the anatomical structure of the leaf shows it to be closer to *D. homomallum* than to *D. tortile*. Doubtful forms occur, and indeed Loeske's view is that both *D. vaginans* and *D. zonatum* intergrade with *D. homomallum*.

4. Ditrichum subulatum Hampe (*Trichostomum subulatum* Bruch; *Leptotrichum subulatum* Hampe, Schp. Syn.) (Tab. VIII. G.).

Plants short, slender, in loose, silky, *bright yellowish green* tufts. Leaves *flexuose when dry*, the lower small, ovate-lanceolate, the upper from a short oval base *abruptly narrowed to a long, flexuose, setaceous*, almost entire subula, the greater part of it composed of the broad, excurrent nerve. *Margin plane*. Cells rather laxer, broader and shorter than in the last species. Perichaetial bracts sheathing. Seta slender; capsule erect, *golden brown, ovate*, wider than in the last species, broadest near the base; annulus almost obsolete; lid shortly rostellate. Peristome teeth very slender, divisions slightly coherent; basal membrane very short. *Paroicous;* antheridia naked, in the axils of the upper leaves immediately below the perichaetial bracts.

HAB. On crumbling rocks and clay soil; very rare. Cornwall; Devon. Fr. spring.

A Mediterranean species which has reached our southern coast. Clearly distinguished by its paroicous inflorescence, and the bright green flexuose leaves, with nerve longly excurrent.

5. Ditrichum flexicaule Hampe (*Didymodon flexicaulis* Schleich.; *Leptotrichum flexicaule* Hampe, Schp. Syn.; *L. infuscatum* Stirt. in Ann. Scot. Nat. Hist. xii, 112) (Tab. VIII. H.).

Tall, slender, in close soft silky tufts, yellowish or brownish green, glossy; *stems 1–6 inches high*, very slender, flexuose, fragile, branched, radiculose. *Leaves very long*, rather loosely set, erect or secund, occasionally falcato-secund, slightly flexuose when dry, from an elongate lanceolate base narrowed to a long fine subula, nerve flattened and indistinct at base, excurrent, denticulate at apex; margin plane, incurved above, cells at base irregularly rectangular, rounded-quadrate towards margin, towards the nerve longer, narrowly rectangular; *in the upper part of the leaf oval and rounded;* one or two rows at the margin of the expanded part are sometimes very narrow and hyaline. Capsule erect, reddish brown, ovate or elliptic, small; annulus broad; lid rostellate; peristome teeth fragile, unequal. *Dioicous; male* plants rare, slender; bracts ovate, subulate.

Var. β. *densum* B. & S. (*Leptotrich. flexicaule* var. *densum* Schp. Syn.; *L. compactum* Stirt. in Ann. Scot. Nat. Hist. xv, 111.) *Densely tufted*, bright or darker green, stems *shorter*, 1–2 inches high; leaves erect, *short*, almost entire at apex.

HAB. Limestone rocks and earth; frequent. The var. β less common, usually in more mountainous districts. Fr. summer, very rare, only found in two spots in Perthshire in 1902 (*Stirton and Haggart*).

Quite distinct in its much greater size, longer leaves, and shortly oval upper cells. It has more resemblance to *Dicranodontium longirostre* than to any other moss, but is easily recognised by the absence of inflated auricles at base.

The var. β in its best marked forms differs greatly in appearance from the type. The leaves are occasionally very short, in which case it is the var. *brevifolium* Kindb., (cf. The Bryologist, iv, p. 50). The cells also are usually shorter than in the type, often rounded or shortly oval throughout the greater part of the leaf. *D. Drummondi* Ferg. according to a specimen authenticated by the author must, I think, certainly be placed here. At the other extreme is the var. *longifolium* Zett., to which some of our Scotch plants, at least, may be referred.

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12. SWARTZIA Ehrh.

(Distichium *B. & S.*, Schp. Syn. et plur. auct.).

Plants in dense silky tufts, slender. *Leaves distichous, subulate, sheathing at base*, smooth; areolation narrow. *Capsule ovate or cylindric*, lid conical. Peristome of 16 teeth not confluent at base, linear-lanceolate, more or less cleft into unequal,

slightly coherent divisions, or variously perforated, sometimes entire.

The distichous leaves are the marked characteristic of this genus, which otherwise much resembles the last. The name Distichium by which it has been usually described was forestalled by Distichia *Nees* (1843), a genus of Juncaceae.

DERIV.—After Olaf Swartz, an eighteenth century botanist.

{Plant 1–6 inches, glossy ; capsule oblong or cylindric, erect.....*1. montana*
{Plant ½–1 inch, dull green ; capsule rounded-ovate, inclined.....*2. inclinata*

1. Swartzia montana Lindb. (*Bryum montanum* Lamarck ; *Distichium capillaceum* B. & S., Schp. Syn. et plur auct.) (Tab. VIII. I.).

In dense silky *bright or dark green glossy tufts*, reddish brown below, very slender ; 1–6 inches high, stems radiculose, straight. Leaves from a *white sheathing* oval-oblong base, *abruptly narrowed above and suddenly reflexed* in a long, spreading or squarrose, setaceous subula, which is densely papillose on the nerve and crenulate at margin ; nerve excurrent at apex, less papillose, but somewhat denticulate ; cells narrowly rectangular at base and pellucid, obliquely elliptical above, in the subula rounded-quadrate and papillose. Perichaetial bracts two, longly sheathing. Capsule on an elongated seta, *erect or very slightly inclined, oblong or cylindric*, bright or brownish red, glossy. Peristome teeth pale red, irregularly cleft, short, *narrow*. Spores 17–20 μ. *Paroicous ; antheridia naked in the axils of the uppermost leaves.*

HAB. Mountain rocks and crevices. Frequent on all our mountains. Fr. summer.

A very pretty plant, easily recognised by its distichous, setaceous leaves, with very conspicuous white, glossy, sheathing bases, so that the stems appear white and shining. In the more compact forms the two ranked arrangement of the leaves is very obvious, in the more elongated forms with distant leaves this is much less distinct. The leaves, except in the compact forms, are very flexuose at apex when dry.

The plant varies much in height of stem, length of leaf, and form of capsule; the more luxuriant forms being associated with longer leaves and narrowly cylindrical fruits, while the most compact, short forms have also the leaves short and almost straight, and the capsule much shorter and ovate. There is, however, every gradation from the one extreme to the other, and no clear line of demarcation can be drawn to define the var. *compacta* (Huebn.) (*D. capill.* var. *brevifolium* B. & S., Schp. Syn.). I have also seen short elliptical capsules on forms with elongated stems and leaves, so that the correlation of the parts is not a distinctive feature of the variety.

2. Swartzia inclinata Ehrh. (*Distichium inclinatum* B. & S., Schp. Syn.) (Tab. VIII. J.).

Plants shorter, of a duller green, *less shining ;* leaves more crowded and less evidently distichous, the sheathing base less

conspicuous, *the subula more erect;* the cells slightly longer and more uniformly rectangular; perichaetial bracts three. Capsule *small, rounded-ovate, turgid, cernuous*, brown, with a dark purple shining mouth; *peristome teeth broader*, red, less deeply bi-trifid or nearly entire. *Autoicous; male flower gemmiform*, below the female, *with 1–3 short, subulate bracts*. Spores 30–40 μ.

HAB. Stony ground in mountainous districts, rare. Scotland; Ireland; Wales; Yorkshire; Derbyshire. Fr. summer, some weeks later than the last species.

The characters italicised will serve easily to distinguish this species from the shorter forms of the last. I do not find any constant difference in the size and width of the leaves.

I have gathered at Durness in Sutherland, a form exactly parallel to the var. *compacta* of the last species and quite as well marked.

Tribe 2. Seligerieae.

13. SELIGERIA B. & S.

Minute, gregarious or caespitose plants, growing on rocks. Leaves lanceolate or subulate, cells minute above, at basal angles rarely coloured (not coloured in any of the British species). *Calyptra cucullate.* Capsule smooth, symmetrical, or only very slightly unequal, ovate, with a distinct neck, peristome teeth usually entire, rarely cleft, smooth, sometimes wanting. Autoicous in all the British species.

A genus of dwarf, almost microscopic plants, often growing on the perpendicular sides of chalk-pits and cliffs, and somewhat difficult, on account of the minuteness and general similarity of the species, to discriminate. Their presence is at times hardly distinguishable except by the slight green or brownish tinge they confer on the substratum of chalk or rock.

DERIV.- After Seliger, a Silesian pastor and bryologist.

1 { Peristome absent ..... *1. Doniana*
  { Peristome present 2

2 { Seta arcuate when moist ..... *6. recurvata*
  { Seta straight when moist 3

3 { Capsule oval or oblong, contracted at mouth ..... *4. paucifolia*
  { Capsule short, wide-mouthed, turbinate when dry and empty 4

4 { Perichaetial ls. reaching base of capsule ..... *2* .acutifolia*
  { Leaves not reaching base of capsule 5

5 { Ls. imbricated in three ranks; cells long and narrow ..... *3. tristicha*
  { Ls. not three-ranked; cells shorter 6

6 { Ls. with short, wide, obtuse subula, entire ..... *5. calcarea*
  { Ls. longer, with narrow, acute subula, faintly denticulate ..... *2. pusilla*

1. **Seligeria Doniana** C.M. (*Gymnostomum Donianum* Sm.; *Anodus Donianus* B. & S., Schp. Syn. et plur. auct.) (Tab. VIII. K.).

Very minute, gregarious, *yellowish green;* stem very short, simple. Leaves erect, straight, subulate from an ovate-lanceolate *denticulate* base, channelled; nerve reaching apex or slightly excurrent, occupying the greater part of the minutely denticulate subula; cells of base very thin, pellucid, rather incrassate, rectangular and rhomboid, upper shorter, quadrate. Capsule on a *straight seta*, minute, pale, *hemispherical or turbinate* after the fall of the lid, *thin-walled, gymnostomous;* lid obliquely *conical*. Male inflorescence on a basal branch.

Hab. Sandstone and limestone rocks. Not common. Fr. late summer.

One of the most minute of our mosses, and easily overlooked. Hardly distinguishable from *S. pusilla* except by the absence of peristome and the somewhat more delicate habit; the denticulate leaf-margin will aid in distinguishing it from the other species.

2. **Seligeria pusilla** B. & S. (*Afzelia pusilla* Ehrh.) (Tab. VIII. L.).

Very short, in loose, *dark green* tufts. Lower leaves short, lanceolate-subulate, upper longer, subulate from an oval-lanceolate *denticulate* base, resembling those of the last species, but longer. Areolation as in that species. Capsule *oval-pyriform, turbinate* after the fall of the lid, brownish green; lid obliquely rostellate; *peristome teeth broadly lanceolate*, entire, flat, distantly articulated, spreading and reflexed when dry, incurved when moist. Male inflorescence below the female or on a separate branch.

Hab. Damp limestone or sandstone rocks, not common. Fr. summer.

Somewhat variable in size, and in length of leaves. The turbinate, peristomate capsule elevated far above the leaves on a straight seta and the minutely denticulate leaf-margin, are the distinguishing marks of this species.

* **Seligeria acutifolia** Lindb. (as a species) (*S. pusilla* var. *acutifolia* Schp. Syn.) (Tab. VIII. M.).

Leaves from a narrower base, contracted into a subterete *very acute, less denticulate subula*, formed almost entirely of the nerve, and very long in the upper leaves; *areolation longer and narrower*. Capsule larger, ovate, *on a shorter seta, hardly elevated above the perichaetial bracts*, shortly pyriform after the fall of the lid, *wide-mouthed when empty;* lid *short*, conical, straighter. Peristome teeth shorter, rather obtuse, fragile.

Var. *β. longiseta* Lindb. Plant larger, *seta longer, so that the capsule is raised above the perichaetial bracts;* lid with a *longer*, oblique beak.

HAB. Calcareous rocks. The var. alone found in Britain; rare. North of England. Fr. summer.

This plant seems to find its right place as a sub-species of *S. pusilla* from which it only differs in the characters pointed out above: and even these are not constant, as indeed the existence of the var. *longiseta* shows. Among plants of the latter form there are, moreover, to be found specimens with the perichaetial bracts overtopping the capsule, though the oblique rostellate lid is always present. It seems best, therefore, to consider *S. acutifolia* as a sub-species of *S. pusilla*, with the var. *longiseta* forming an intermediate link. It would probably have been a more natural arrangement to make this variety the type of the species, and the plant with the short seta the variety.

A further distinguishing character between *S. pusilla* and *S. acutifolia*, which is easily observed and, so far as I have studied the plants, constant, lies in the cells of the outer layer of the seta, which in the former are *narrow-linear, elongate, 4-8 times as long as wide*, while in the latter they are *much laxer, wider, shortly rectangular, 1½-3 times as long as wide*.

3. Seligeria tristicha B. & S. (*Weisia tristicha* Brid.; *Seligeria trifaria* Lindb., Braithw. Br. M. Fl.) (Tab. IX. A.).

Plants resembling *S. pusilla*, but *taller* and *more rigid*, 1–2 lines high, slender, branched, *brownish*. *Leaves regularly imbricated in three rows*, crowded, straight, erect, appressed when dry, from a lanceolate concave base gradually narrowed to a rigid, obtuse or acute, entire subula, composed of the nerve, which is narrower at the base; cells elongate-rectangular at base, shorter above; *margin entire* or very faintly sinuose. Perichaetial bracts longer, the nerve more longly excurrent. Capsule on an elongated seta, *thick-walled, wide-mouthed and hemispherical after the fall of the lid*, with a long neck tapering into the fruit stalk; lid *obliquely rostellate, rather long*. Peristome teeth sometimes perforated.

HAB. Wet calcareous rocks. Very rare. Perthshire; Yorkshire; Derbyshire. Fr. summer.

The stems are often closely tufted, and sometimes very much branched; the leaves are rather brittle; their regular arrangement giving the stems a distinct and peculiar trigonous appearance. The form of the capsule when ripe, together with its neck, is regularly pyriform, the neck varying somewhat in length, sometimes very gradually narrowing downwards. It is readily distinguished by the tall slender stems, and the trifarious arrangement of the leaves. The wide pachydermous capsule, the entire leaves, and narrow cells, are also characters of value, in cases where, as occasionally happens, the tristichous leaf arrangement is not so distinct.

4. Seligeria paucifolia Carruth. (*Bryum paucifolium* Dicks.; *S. subcernua* Schp. Syn.) (Tab. IX. B.).

Plants gregarious, pale dull green, very short, unbranched. Leaves crowded, the upper longer, sub flexuose, longly and finely subulate from a lanceolate, gradually narrowing base, *quite entire*; nerve very indistinct at base, gradually stronger, wide

above and sometimes very slightly excurrent; cells rectangular, shorter above, a single row on each side reaching almost or quite to the apex; *seta erect*, slightly flexuose above; capsule *thick-walled, narrowly oval or oblong*, sometimes slightly asymmetric, *narrowed at the mouth*; lid with an oblique *subulate* beak; peristome teeth narrow, lanceolate.

HAB. Blocks of chalk; rare. Fr. summer.

The narrow elongated capsule, contracted, not expanded, at mouth, on an erect seta, is the most distinguishing feature of this species. It seems to prefer detached blocks of chalk rather than cliffs.

5. Seligeria calcarea B. & S. (*Bryum calcareum* Dicks.) (Tab. IX. C.).

Plants in wide patches, densely gregarious, dull deep green. Stem very short, simple. *Leaves short*, from an oblong concave base abruptly narrowed to a *rather short, linear, somewhat obtuse subula, entire*; nerve indistinct below, above stronger, but flattened and obscure, and occupying the whole apex; cells shortly rectangular, thin and pellucid at base, above irregularly rounded-quadrate, oval or hexagonal, obscure, incrassate, chlorophyllose. Capsule on a straight seta, very slightly larger than in *S. pusilla*, more solid, but otherwise resembling it; peristome teeth broader and more obtuse, more closely articulate.

HAB. Chalk cliffs and limestone quarries. Frequent on the chalk hills of the south and east of England. Fr. spring or early summer.

Easily recognised by its dwarf, stouter habit, with broader, thicker leaf-points, which are also more obtuse, especially in the lower leaves: the upper and perichaetial leaves are more tapering. The nerve is flattened and obscure, so that it is difficult in the subula to say where the lamina ceases and the nerve begins. In the fruit this species most resembles *S. pusilla*. It often forms very wide extended patches on the perpendicular face of chalk cliffs, resembling until more carefully examined, patches of protophytic algae.

Specimens gathered by the Rev. W. F. Thompson in Norfolk, have the seta very short, frequently no longer than the perichaetial bracts. This agrees with the measurements given by Limpricht in his description of the species, but it is certainly not the type as figured in most works, or as represented by the British plant generally.

6. Seligeria recurvata B. & S. (*Grimmia recurvata* Hedw.; *S. setacea* Lindb., Braithw. Br. M. Fl.) (Tab. IX. D.)

In close patches, olive green, usually very fertile; stems short, but rather longer than in the last species, fragile, simple or forked. Leaves erecto-patent, *flexuose*, longly subulate from an ovate-lanceolate base, acute, *entire*; nerve narrow, excurrent but very ill-defined and hardly distinct from the lamina in the subula; cells at base variable, usually rectangular with thin walls, pellucid; above shorter, more quadrate, incrassate. Capsule on a

rather long, *flexuose and arcuate* seta, oval with a short neck, *thin-walled ;* lid with a *slender, straight beak ;* teeth of peristome lanceolate, obtuse or acute.

HAB. Sandstone rocks in shady places. Not common. Fr. spring and summer.

The slender, arcuate seta is the chief characteristic of the present species, and is especially noticeable when the plant is growing, and at the period of ripening of the capsules ; when gathered in this condition the seta remains curved in drying, but older capsules usually dry with the fruitstalk straightened. The capsule is variable in length, the lid sometimes oblique. The tissue of which the capsule is composed is looser than in the other species, the cells being larger with thin walls.

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14. **BRACHYODUS** Fuernr.

(Brachydontium *Bruch*, Braithw. Br. M. Fl.)

Plants very small, resembling Seligeria. *Calyptra mitriform*, 5–lobed. Capsule erect, oblong, *finally striate ;* peristome teeth *confluent at base*, broad, *very short and truncate*, dotted, thin.

DERIV. —βραχυ-(brachy) short and ὀδους (odous) a tooth, from the short peristome teeth.

1. Brachyodus trichodes Fuernr. (*Gymnostomum trichodes* W. & M. ; *Brachydontium trichodes* Fuernr., Braithw. Br. M. Fl.) (Tab. IX. E.).

Plants resembling *Seligeria pusilla ;* very small, simple, gregarious, green or brownish. Leaves straight, lanceolate-subulate, channelled, entire ; nerve excurrent, forming the whole of the upper part of the subula ; cells hexagonal-rectangular below, irregularly quadrate above. Capsule on a slender seta, *oblong, pale, thin-walled*, red at mouth, when old more or less pyriform, darker coloured, and *finely striate ;* calyptra conical, *3–5 lobed at base ;* annulus broad ; lid conical with a straight subulate beak ; peristome teeth irregular, perforated, pale, smooth, *very short*. Autoicous.

HAB. Wet sandstone rocks. In mountainous and hilly country, not common. Fr. early spring.

Much resembling a Seligeria in habit and leaf structure, this is easily recognised under a good lens by the oblong capsule on a straight seta, with very fine longitudinal striations ; in leaf it is perhaps nearer *S. paucifolia* than any other.

Tribe 3. Cynodontieae.

15. SAELANIA Lindb.

Plants small; leaves small, linear or lanceolate, *smooth; glaucous at back with cellular, granulose "bloom."* Capsule oblong-cylindric, *erect, slightly furrowed when dry; lid conical;* peristome teeth 16, irregular, cleft to base into two narrow, nodose, papillose divisions, usually much connected above.

The plant for which Lindberg created this genus has usually been placed under either Ditrichum or Trichostomum, and it certainly holds, as pointed out by Braithwaite, a somewhat intermediate position between Tortulaceae and Dicranaceae. Its affinity with Ceratodon is however so obvious (while at the same time it shows distinguishing characters of some importance), that its consignment to a separate genus near that one appears the most satisfactory arrangement.

Deriv.—After Saelan, a Scandinavian bryologist.

1. Saelania caesia Lindb. *Bryum caesium* Villars; *Leptotrichum glaucescens* Hampe., Schp. Syn.) (Tab. IX. F.).

In dense *glaucous bluish green* tufts, brown below, half to one inch high. Stems erect, slender, much branched. Leaves *small*, broadly lanceolate below, larger and longer at the summit of the branches, forming a coma; erecto-patent, slightly twisting at the point, somewhat flexuose when dry; *acutely linear or linear-subulate from a lanceolate or oblong base*, margin *plane, bluntly serrate* above; nerve distinct, slightly excurrent in the longer leaves; cells all rectangular, at base empty, 4–6 times as long as broad, above *about twice as long as broad, or sometimes quadrate*, chlorophyllose; in the lower leaves more uniform. Capsule *erect* on a short seta, oval-oblong, thin-walled, brown, irregularly plicate when dry and empty; annulus yellow, of two rows of cells; lid acutely conical; peristome conical, the teeth purple, the divisions much united above. Autoicous; male flowers gemmiform, on short branches below the perichaetia.

Hab. On earth in clefts of rocks in alpine districts; very rare. Glen Phee, Clova. Fr. late summer.

This rare species will be recognised at once by the bluish green colour, a feature hardly shared by any other British moss, though in a small degree by *Weisia verticillata*, which differs markedly in the leaves, denticulate towards base, but entire above, and is of quite a different habit of growth. The leaf-cells are longer and narrower than in Ceratodon.

16. CERATODON Brid.

Plants terrestrial, tufted; leaves small, lanceolate, smooth or slightly papillose. Capsule oval or oblong-cylindrical, *striate*,

when dry sulcate, often inclined, with a distinct neck, thick-walled. *Lid conical.* Peristome teeth 16, cleft regularly nearly to base into two filiform divisions, closely articulate below, remotely above, papillose.

DERIV.—κερατο-(kerato) horn, and ὀδους (odous) a tooth, from the resemblance of the peristome teeth to a goat's horns.

{Nerve not or scarcely excurrent ; capsule strumose at neck...*1. purpureus*
{Nerve longly excurrent ; capsule less distinctly strumose.....*1*. conicus*

1. Ceratodon purpureus Brid. (*Mnium purpureum* L. ; *Ceratodon vialis* Stirt. in Ann. Scot. Nat. Hist. xiv, 105 ; *Hypnum recurvulum* Stirt. op. cit., ix, 180) (Tab. IX. G.).

In wide patches, of various tints of green, often accompanied by a tinge of vinous red. Stems branched, ½–3 inches long, slender, erect. Leaves erecto-patent, rather laxly imbricated, slightly twisted and appressed when dry, from broadly triangular-ovate to narrow linear-lanceolate, concave, margin revolute from base upwards, *becoming plane just below the apex, where there are usually a few coarse teeth ; nerve reaching apex or very slightly excurrent ;* cells at base pellucid (in the longer leaves), rectangular, 3–5 times as long as broad, above regularly quadrate, hexagonal-quadrate, or irregular, but always short, small, chlorophyllose. Perichaetial bracts longer, sheathing. Capsule on a purple or sometimes yellowish shining seta, *inclined*, oblong (when dry and empty oblong-cylindrical), straight or slightly curved, purplish or reddish brown ; when dry cernuous or horizontal, *sulcate, 4–5 angled*, with a small but *distinct struma* at base ; annulus large, lid acutely conical, slightly curved. Peristome teeth deep red at base, with equal divisions, bordered on each side from base to middle by the wider inner layer of plates. Dioicous. Male plants more slender, flowers gemmiform.

HAB. Sandy and peaty soil, banks in woods, etc. ; very abundant, and cosmopolitan. Fr. spring and early summer.

One of the most abundant and polymorphous of our mosses, easily known when in fruit by the narrow, inclined, sulcate, strumose capsule with conical lid. There is a peculiar look about the leaves when viewed under the microscope, which, allowing for a certain amount of variation in form and size of both leaf and areolation, is directly recognised after a little practice ; the margin recurved to just below the apex, then plane and toothed, is one of the most distinct and constant features ; when moist the leaves usually have a shiny appearance, and the comal ones are generally slightly twisted ; this taken in conjunction with their channelled surface and gradually acute outline, will serve for identification in the field, and an acquaintance with their appearance under the lens will save the beginner much labour and disappointment.

Several varieties have been described, among them var. *brevifolius* Milde, with small, wide, shortly pointed leaves, mucronate with the excurrent nerve ; I have seen British forms agreeing with this description. They resemble *Barbula lurida* in appearance, but the leaves are usually laxer, and are apiculate with the excurrent nerve. A form also occurs with abnormal leaves, widely rounded and obtuse at apex, with the nerve ceasing below.

* **Ceratodon conicus** Lindb. (*Trichostomum conicum* Hampe; *Grimmia halophila* Stirt. in Ann. Scot. Nat. Hist., ix, 177) (Tab. IX. H.).

The typical, or extreme form of this plant differs from *C. purpureus* in the following points. Stems shorter, usually yellowish green; leaves small, short, ovate-lanceolate, the upper erecto-patent, *crowded into a coma*, less twisted when dry, *the margin revolute to apex, entire; the nerve excurrent in an arista* or point of varying length; cells small. Capsule *erect or very slightly inclined*, ovate-elliptic, rather wide at base, when dry and empty hardly altered, *slightly sulcate, the neck not or only slightly strumose;* lid shortly and obtusely conical. Peristome teeth pale, *with fewer articulations, with very narrow and less distinct borders.*

HAB. Bare places and mud-caps of walls. Rare. Fr. summer.

The examination of a considerable number of specimens from different localities has convinced me that the present plant should not rank higher than a sub-species of *C. purpureus* at most; a conclusion arrived at for the most part on account of the existence of a number of intermediate forms linking it, in an unbroken chain, with that plant. Specimens found by me in Scotland in 1883 have the fruiting characters exactly those of *C. conicus*, but the plant has the purplish hue common in the typical form and the nerve is excurrent in a very short point only. Since that time, in a number of localities in Northamptonshire, uniformly on the mud-caps of walls in the oolitic districts, I have found plants which, while with the peristome and the foliage of *C. conicus* (the nerve being excurrent in a point frequently as long as the whole of the rest of the leaf), show a great variation in the capsule, both as regards its inclination and form, the struma, and the lid; sometimes being barely if at all distinct from ordinary *C. purpureus*, at others, though more rarely, with capsules almost exactly characteristic of *C. conicus*, while specimens may be found of nearly every intermediate form. It must be remembered too that the nerve is sometimes excurrent in otherwise typical *C. purpureus*.

In the Northamptonshire localities above mentioned, this plant even when barren and growing with *C. purpureus*, may be generally recognised with the eye alone, by the denser, neater tufts, with the shorter, aristate, upper leaves forming a comal tuft.

C. minor Aust. (Lesq. & James, Manual of Mosses of N. America, p. 92) appears to be this plant; the only difference according to the description, being that in that moss the leaves are spoken of as serrulate towards the apex.

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17. RHABDOWEISIA B. & S.

Plants *short*, inhabiting rock crevices, densely cushioned. Leaves *linear or ligulate*, not much attenuated at point, short, *much crisped when dry, with plane margins;* areolation short, more or less quadrate above. Capsule erect, *symmetrical*, minute, on a very short seta, *striate, not strumose*. Peristome *small*, teeth narrow, subulate, undivided.

The three plants here included have a distinct habit and in other respects form a natural group, though linked to

Cynodontium by *C. Bruntoni*, which however clearly belongs to that genus. Their short, highly chlorophyllose, plane-margined pellucid leaves abundantly distinguish them, in addition to which they are usually found fertile.

DERIV.—ῥαβδο-(rhabdo) a fluted column, alluding to the striated capsule, otherwise resembling Weisia.

1 { Leaves with narrow tapering points, almost entire.....*1. fugax*
  { Leaves with wider, more obtuse points, serrate.....2

2 { Plant small; leaves narrow, cells 8–10 μ.....*2. denticulata*
  { Plant ½–1 inch; leaves broader, more coarsely toothed, cells 14–18 μ *3. crenulata*

1. Rhabdoweisia fugax B. & S. (*Oncophorus striatus* Lindb., Braithw. Br. M. Fl.) (Tab. IX. I.).

Bright or dark green, in short, soft, dense tufts or cushions; leaves *narrowly linear or ligulate*, curled when dry, *shortly acuminate, more or less acute*; margin plane, faintly denticulate or almost entire at apex; nerve ceasing below the summit; areolation rectangular at base and pellucid, gradually becoming quadrate, in the upper part *in 6–8 (rarely 8–9) regular rows* on each side the nerve of rounded-quadrate or transversely elliptical cells, somewhat incrassate, *9–14 μ wide*, faintly papillose, chlorophyllose. Capsule on a very short seta (1–2 lines), very small, pale, erect, symmetrical, oval, wide-mouthed and urceolate when dry and empty, distinctly striate; lid with a curved, subulate beak, as long as the capsule. Peristome teeth suddenly subulate from a broad base, reddish, *very small and fugacious*.

HAB. Clefts of rocks in alpine and subalpine districts. Not common. Fr. summer.

A pretty little moss, usually covered with capsules. The peristome is so fragile that it generally falls off almost as soon as the lid separates. The leaves vary somewhat in outline and in the amount of denticulation of the point.

2. Rhabdoweisia denticulata B. & S. (*Oncophorus crispatus* Lindb., Braithw. Br. M. Fl.) (Tab. IX. J.).

Resembling the last, but with shorter, *wider, more obtuse* leaves, the margin in the upper part more strongly toothed, with closer, more acute, and more spreading denticulations; the upper cells *8–10 μ wide*, on each side of the nerve in *7–9 rows* of quadrate or quadrate-hexagonal cells with thinner walls. Capsule the same or a little larger and somewhat more elongated, often of a rather darker colour and more solid texture. Peristome teeth subulate from a lanceolate base, articulated, longer, *more persistent*.

HAB. As the last, but rather more frequent. Fr. summer.

A slightly more robust plant than *R. fugax;* the characters above mentioned serving to identify it without much difficulty. The differences in the capsules often described are by no means constant.

3. Rhabdoweisia crenulata Jameson, Rev. Bry. 1890, p. 6; (*Oncophorus crenulatus* Braithw., Br. M. Fl. I, p. 300; *Didymodon crenulatus* Mitt.; *Leptodontium Rossii* Stirt. in Trans. & Proc. Bot. Soc. Edin., xxvi, 424) (Tab. IX. K.).

Taller than *R. denticulata* and more robust, ½–1 *inch high.* Leaves lingulate, *broader, obtuse,* recurved at apex, margin in the upper part closely crenulate-denticulate with projecting cells; areolation in upper part, on each side of nerve, in *10–13 rows* of *larger,* irregularly quadrate or hexagonal, *obscure* cells *14–18 μ wide.* Capsule a little larger, reddish; peristome teeth narrow, erect, reddish.

HAB. Shady rock crevices. Rare. North of England; Wales; Scotland. Fr. summer.

Much like the last and often confused with it, but easily recognised by the leaves much broader in the upper part with larger, more obscure cells. In favourable situations it becomes so robust as to resemble closely *Trichostomum tenuirostre* or *T. mutabile* var. *littorale. Leptodontium Rossii* Stirt. is one of these forms, larger than I have seen it elsewhere in Britain.

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18. CYNODONTIUM B. & S.

Plants *taller* than in Rhabdoweisia, leaves with *recurved margins,* long, *wider at base, gradually and longly acuminated in the upper part;* cells often papillose. Fruit *larger,* smooth or striate, *symmetrical or more frequently inclined and unequal, often strumose,* on a longer seta. Peristome variable. Lid longly subulate.

Resembling Dicranum in the fruit, this genus differs in the leaves without distinctly marked angular cells, usually erecto-patent, and crisped when dry. *C. Bruntoni* unites it with Dicranoweisia, but the denticulate leaves with recurved margins serve to distinguish it, and the angular cells are not distinct from the rest.

A continental species, *C. schisti* Lindb., forms a transition between this and the last genus, having the leaves almost entire, with recurved margins, the capsule striate and equal, the peristome more perfect and less fugacious than in Rhabdoweisia.

DERIV.—*κυνο-*(kyno) dog, and *ὀδοντ-*(odont) tooth; from a supposed resemblance in the peristome teeth of *C. Bruntoni.*

1 { Capsule distinctly strumose at neck.....2
  { Capsule not strumose.....4

2 { Capsule smooth; leaves not papillose.....3
  { Capsule furrowed when dry; leaves papillose.....2*. *strumiferum*

3 { Leaves gradually lanceolate from an oval or oblong base.....*3. virens*
  { Leaves suddenly subulate from a wide, obovate base.....*3*. Wahlenbergii*

4 { Capsule when dry faintly and irregularly striate only.....*1. Bruntoni*
  { Capsule when dry distinctly and regularly furrowed.....5

5 { Leaves rather obtuse, strongly papillose on both sides.....*2*. gracilescens*
  { Leaves acute, smooth, or papillose at back only.....6

6 { Cells small, 8–12 μ, papillose at back.....*2. polycarpum*
  { Cells large, 12–20 μ, quite smooth.....*2*. Jenneri*

1. Cynodontium Bruntoni B. & S. (*Dicranum Bruntoni* Sm.; *Dicranoweisia Bruntoni* Schp. Syn.; *Oncophorus Bruntoni* Lindb., Braithw. Br. M. Fl.) (Tab. IX. L.).

Densely tufted in compact soft yellowish or dull green cushions, 1–1½ inches high. Lower leaves elongate-lanceolate, upper longer, from an oblong base gradually narrowed upwards to an acute point, carinate-concave, spreading and somewhat recurved at summit when moist, strongly curled when dry; margin recurved, *remotely denticulate in the upper half;* nerve strong, continued to apex, roughish at back above; cells at base pellucid, rectangular, shorter at margin, above becoming elliptical and incrassate, in the limb very small, rounded or irregularly quadrate, obscure, minutely papillose. Perichaetial bracts half-sheathing, shortly acuminate. Capsule on a yellowish seta (2–4 lines), *oval or oval oblong,* slightly contracted at the mouth, *erect, equal or very slightly one-sided,* short-necked, *smooth,* when dry faintly plicate, pale brown; annulus narrow, lid shorter than the capsule. Peristome teeth *small, irregular,* unequally cleft, the divisions free or cohering, smooth.

HAB. Clefts of rocks in subalpine districts. Not common. Fr. summer.

This species is not likely to be mistaken when fruiting for any of the species included under the present genus, all of which have the capsule either strumose or distinctly striated: it is more likely to be confused with *Dicranoweisia crispula* and *D. cirrata;* the former, however, is readily known by the plane margins of its leaves, and the latter by the elongated capsules and entire leaves. It should also be borne in mind that the two plants of that genus when growing on rocks are usually found on their surface, while the present plant is mostly confined to *clefts* of rocks. When barren it is very difficult to separate from the next species, though the leaves are somewhat shorter and less finely pointed, and the cells a little smaller.

2. Cynodontium polycarpum Schp. (*Dicranum polycarpum* Ehrh. *Oncophorus polycarpus* Brid., Braithw. Br. M. Fl.) (Tab. IX. M.).

Usually taller and more robust than the last species, 1–2 inches high, of a paler green. Leaves longer and gradually larger upward, when dry flexuose but not much curled or circinate, longer than in the last species, narrowly linear-lanceolate, finely tapering at the point, margin recurved, towards apex *thickened*

and usually with a single or double row of denticulate crenulations; cells at base elongate-rectangular, above small, 8–12 μ, rounded-quadrate or irregular, *smooth or finely papillose at back above.* Marginal cells in upper part of leaf *in two layers.* Perichaetial bracts sheathing, longly acuminate-subulate; seta straight, about five lines long, capsule erect or unequal and slightly inclined, *oblong-cylindrical with a short symmetrical neck, pale, distinctly and regularly sulcate when dry;* annulus distinct, separating, of 3 rows of cells; lid conical-rostrate, shorter than the capsule, *crenulate-sinuose at margin.* Peristome teeth *perfect,* cleft half-way into two unequal divisions, undivided part with 8–15 transverse bars on the outer surface.

Hab. Rocks in mountainous districts; rare. Fr. summer.

This species is subject to considerable variation, in points however which very little affect its general appearance, the form and serrature of the leaves, the amount of papillosity of the cells, and the general size of the plant, being the characters most affected.

C. polycarpum may be readily recognised by its narrow, striated, slightly unequal fruit. Except in its pale colour there is a certain superficial resemblance to *Ceratodon purpureus.* The differences between it and the allied plants of the present genus will be found noticed under the several species.

* **Cynodontium strumiferum** De Not. (*Dicranum strumiferum* Ehrh. *Cynodontium polycarpum* var. *strumiferum* Schp. Syn; *Oncophorus strumifer* Brid., Braithw. Br. M. Fl.) (Tab. IX. N.).

Leaves with the *upper cells more papillose, in front as well as at back.* Capsule broader, inclined and slightly arcuate, *gibbous at back, with a distinct struma at base in front.*

Hab. Rocks on the higher mountains; rare. Fr. late summer.

The variations that occur in the form of the capsule, the varying amount of papillosity in the leaves, and the occasional presence of a rudimentary struma in *C. polycarpum* tend to show that the characters distinguishing *C. strumiferum* are hardly of sufficient importance to constitute specific rank. The papillae on the leaves are by no means distinct in some specimens with the typical capsule of *C. strumiferum.*

* **Cynodontium gracilescens** Schp. (*Dicranum gracilescens* W. & M.; *Oncophorus gracilescens* Lindb., Braithw. Br. M. Fl.) (Tab. X. B.).

Differs from *C. polycarpum* in its *more slender habit,* the leaves *slightly broader and more obtuse,* usually *more strongly papillose both on back and front,* the margin less recurved above; *the perichaetial bracts more shortly acuminate;* the seta *slender and flexuose,* the neck of the capsule small and inconspicuous, *not*

strumose, the lid *smooth at margin*, the annulus rather narrower, of 2 rows of cells, and *persistent*.

HAB. Alpine rocks; very rare. Clova; Wales. Fr. late summer.

The greater number of the above characters are subject to more or less variation. In the compact var. *alpestre* (*Cynod. subalpestre* Kindb.) the papillosity of the leaves almost disappears, and the perichaetial bracts hardly differ from those of *C. polycarpum*; it is indeed placed under that species by Boulay, and may be looked upon as a connecting link between the type and the present sub-species. The smallness of the distinctive characters as described above, justifies, I think, its present arrangement as a sub-species rather than as a separate species, although I am not aware that a similar view has been taken by any of the authorities since C. Mueller (*Syn. II. p. 591*).

* **Cynodontium Jenneri** Stirt. in Ann. Scot. Nat. Hist., xv, 106 (*C. polycarpum* var. *laxirete* Dixon, Handb. Ed. 1; *C. laxirete* Grebe in Hedwigia, 1901, p. 106, Handb., Ed. 2; *C. polycarpum* var. *laevifolia* Hagen, Musc. Norv. borealis, p. 8) (Tab. X. A.).

Resembling *C. polycarpum*, but more robust. Leaves *larger, broader, not tapering to a fine point;* margin towards apex flat, *not thickened*, coarsely toothed or almost entire. Upper cells *much larger*, 12–20 μ, more regularly quadrate, *quite smooth*, more transparent and less obscure, marginal cells *in a single layer*. Capsule somewhat longer, with a long and very distinct neck, which is in the young state swollen at the base of the spore sac so as to form almost an apophysis, in the empty capsule very long and tapering. Annulus of 2 rows of cells. Peristome teeth with 15–20 transverse bars.

HAB. Rocks in mountainous districts. Scotland; Westmorland; Carnarvon.

This plant was first described as *Didymodon Jenneri* Schimp., in 1868, from Scotch specimens. It was subsequently detected in various localities in Scotland and on the Continent, and described independently under several names. Grebe was the first to raise it (under this genus) to the rank of a species, pointing out certain distinguishing characters in addition to those described in the 1st Edition. I have followed his view so far as to consider it a sub-species of *C. polycarpum*. It is to say the least as distinct from *C. polycarpum* as are *C. gracilescens*, *C. strumiferum*, and several other continental species of recent creation; and whatever position these hold must be equally accorded to it. The larger, broader leaves give it a more robust habit than *C. polycarpum*, while the elongated cylindrical capsule with distinct and well-marked neck separates it easily from the allied plants.

3. Cynodontium virens Schp. (*Bryum virens* Sw.; *Oncoph. virens* Brid., Braithw. Br. M. Fl.) (Tab. X. C.).

Plants *tall, robust*, 2–3 inches high, *bright green above*, brown or black below, in dense tufts, stems repeatedly forked. Leaves spreading, not increasing in length above, slightly crisped when

dry, from an *oval or oblong* amplexicaul base *gradually* narrowed and lanceolate, acute or obtuse, carinate; margin recurved, entire, or sub-serrate above; nerve reaching apex or slightly excurrent; cells of leaf-base rectangular, pellucid, shorter and broader towards the margin, becoming shorter and incrassate above, in the limb shortly rectangular and almost quadrate, *smooth*. Capsule *dark reddish brown*, oblong-cylindrical, arcuate, gibbous, *with a sharp distinct struma*, *smooth*. Peristome teeth large, regular, cleft to the middle.

Var. β. *serratum* B. & S. Leaves widely spreading, *coarsely serrate in the upper part.*

HAB. Wet rocks and stony ground on high mountains. Common on the Grampian range; elsewhere rare. The var. β in similar situations. Fr. late summer and autumn.

This fine species varies much in size, in the magnitude of the cells and the thickness of their walls, and in the length, form and serrature of the leaves; and no clear line can be drawn between the type and the var. *serratum*. It cannot easily be mistaken for any other moss, at least when examined under the microscope.

* **Cynodontium Wahlenbergii** Ren. & Card., Rev. Bry. 1892, p. 74. (*Cynodontium virens* var. *Wahlenbergii* Schp. Syn.; *Oncoph. Wahlenbergii* Brid., Braithw. Br. M. Fl.) (Tab. X. D.).

Resembling *C. virens* but usually shorter; *leaves more distant*, more strongly crisped when dry, from an *obovate* base *suddenly contracted to a longer, narrower*, subulate, flexuose point. Capsule slightly shorter and thicker.

Var. β. *compactum* B. & S. Tufts *short, dense;* leaves *crowded*, more erect, shorter, from a smaller base. Capsule *smaller*, less solid, short.

HAB. High alpine rocks. Rare. The var. β on the higher Grampians; Perthshire. Fr. late summer.

The leaf-base in *C. virens* is normally oblong, hardly wider above than at the insertion, and very gradually contracted into the limb, which is usually short, and rather quickly narrowed to the apex. In *C. Wahlenbergii* the leaf-base is very short and broad, widening considerably upwards from its line of insertion, then suddenly narrowing (so as to form a shoulder), into the much narrower and longer, linear-subulate limb. Although, however, there is a wide distinction between these two extreme forms, there are found many intermediate links, leaves of various forms often occurring on the same stem; indeed, I have never examined a tuft of *C. virens* without finding some leaves that showed an approach to the leaf-form of *C. Wahlenbergii*. The var. *compactum* too, while usually clearly referable to the sub-species, has the leaves, in several specimens which I have examined, far from showing the *typical* Wahlenbergii form, being indeed intermediate between the two. I have, therefore, felt compelled to deny *C. Wahlenbergii* full specific rank, although in its most extreme form, did that alone exist, it might well lay claim to such a position.

19. **DICHODONTIUM** Schp.

Plants loosely tufted, usually growing near rocky streams; leaves *spreading or squarrose, broad,* opaque, *papillose.* Capsule *smooth,* thick-walled, *peristome large, dicranoid.*

The plants of this genus are very distinct from the rest of the Order in the broad, obtuse, papillose leaves with plane margins, at least in the upper half. They are, indeed, more likely to be referred by the beginner to Tortulaceae than to Dicranaceae. The peristome is quite distinct, but more often than not the fruit is wanting. Few of the species of Tortulaceæ, however, for which the student is at all liable to take either of these plants, have the spreading, denticulate leaves of *D. pellucidum* or the coarsely serrate leaf margins of *D. flavescens.*

Oreoweisia serrulata Schp. has been recorded from Ben Lawers by Dr. Stirton, but its claim to be regarded as British is very doubtful. It is a native of the Austrian Alps, and is monoicous, with narrow, serrulate, obtuse leaves, having the basal areolation thin and hyaline, the upper obscure and highly papillose; the habit is more slender than that of Dichodontium.

DERIV.—δι*χο*-(dicho) split in two, and ὀδοντ-(odont) tooth; alluding to the form of the peristome teeth.

{ Leaves rather obtuse, serrulate; capsule cernuous, asymmetrical 1. *pellucidum*
{ Leaves acute, sharply serrate; capsule suberect, symmetrical or nearly so 1*. *flavescens*

1. **Dichodontium pellucidum** Schp. (*Bryum pellucidum* L.) (Tab. X. E.).

Pale or dull green, in rather lax tufts, 1–3 inches high. Stems slightly branched, flexuose, radiculose below. Leaves variously imbricated, but never very densely placed, *spreading or recurved and squarrose* from a more erect base, when dry somewhat appressed, or curled above *with the apex incurved,* varying greatly in length and width, from a *broad, oval or oblong base* narrowed into a longer or shorter, oblong-lingulate, broad, concave limb, *rounded and obtuse or obtusely pointed;* margin recurved below, somewhat undulated above, *incurved at apex,* almost entire or more frequently *crenulate-serrate towards the summit,* limb opaque, studded with *sharp, ascending papillae* on both sides; cells at base elongated, narrowly rectangular, rather pellucid, *with several rows at the margin to the base* shorter and chlorophyllose, in the upper part small, irregularly quadrate or rounded, *obscure.* Nerve thick, vanishing below apex, rough with denticulations at back above. Dioicous. Fruitstalk short, thick, especially towards the top, reddish yellow; capsule *short, oval or subglobose, cernuous,* somewhat gibbous, with hardly any neck, but tapering at base into the fruitstalk, smooth, solid in texture, purplish

brown, exannulate; lid obliquely and shortly rostrate, rather thick. Peristome large, *deep purple red*, the teeth 2–3 cleft, *densely papillose at apex, vertically striate below*, from a rather high basal membrane.

Var. β. *fagimontanum* Brid. Shorter, with shorter branches; *leaves short, more obtuse, hardly spreading;* capsule smaller.

Var. γ. *strictum* Braithw. Stems densely tufted, elongated, slender, *straight*. Leaves distant, *very short, suddenly contracted to a narrow-lingulate* channelled limb, tapering to an *obtuse almost entire point*.

Var. δ. *compactum* Schp. MS. Stems *very densely tufted*, reddish brown below, *very slender; leaves smaller, short*.

HAB. Wet rocks or sandy *débris* near streams; common in mountainous districts, not common elsewhere. The var. β in more alpine districts; Ben Lawers, &c. The var. γ among grass, near Abergavenny. The var. δ not common. Fr. autumn to spring.

A variable plant, but when once known recognised without much difficulty by the form and structure of the leaves. The short, broadly pointed, obtuse leaves distinguish the var. *fagimontanum* from the type. The fruit of *D. pellucidum* is not very commonly produced, and the fertile plant is usually rather smaller and more slender. In the forms with short leaves the basal cells are generally shorter and more uniform, less pellucid.

The specific name is hardly an appropriate one, as the leaves are rather opaque, and even the basal cells are far less pellucid than in most of the species of this Order. Sub-globose stalked gemmae frequently if not normally occur in the axils of the leaves in the upper part of the stem.

D. pellucidum might be, and indeed has been taken, in some of its forms, for *Leptodontium flexifolium*, but the latter is usually a more slender plant, with smaller leaves not expanded at the base, less papillose, and of a different texture.

* **Dichodontium flavescens** Lindb. (*Bryum flavescens* Dicks.; *Dichodontium pellucidum* var. *serratum* Schp. Syn.; *D. fulvescens* Stirt. in Ann. Scot. Nat. Hist., xviii, 245) (Tab. X. F.).

Taller, loosely tufted, *yellowish or dark green*. Leaves more distant, erecto-patent and slightly recurved, but less squarrose than in the last; when dry *twisted but not appressed nor incurved; longer*, from a *narrower base* gradually tapering to a narrower, less obtuse, flat point, faintly undulated; margin slightly less recurved below, *in the whole of the upper part* (and often below the middle) *coarsely denticulate or serrate*. Cells of leaf base more elongate, only *a few rows* (usually 1–3) *at margin quadrate and obscure*, sometimes hardly reaching to base, above incrassate, rounded-quadrate, *minutely papillose*, less obscure. Capsule *erect or suberect, shortly oblong-cylindric, symmetrical or nearly so*, pale brown; peristome either as in *D. pellucidum*, or *paler*, from a very short basal membrane, *not vertically striate* below, *not or sparingly* and rather coarsely papillose above.

HAB. Beds of mountainous streams. Not common. Fr. autumn to spring; rare.

Observations on numerous plants have shown (cf. Rev. Bry. 1903, p. 39) that the form of peristome supposed to be characteristic of *D. flavescens* is not always found in plants with the form of capsule and all the vegetative characters typical. Rarely, too, the peristome itself is somewhat intermediate in character. Either then the plants which have the leaf characters but not the peristome of *D. flavescens*, as described by Lindberg, must be separated from that plant, and a new place found for them, or *D. flavescens* must be founded upon the general leaf character and form of capsule, without relying upon the peristome characters. On the whole I have preferred the latter course, although it must be admitted that each has its disadvantages. For intermediate forms occur connecting the plants having erect symmetrical capsules with *D. pellucidum*, certain forms having the vegetative characters of *D. flavescens* with the fruit of *D. pellucidum*. These forms are, however, rare, and it may generally be assumed in the absence of fruit that plants with the vegetative characters described above for *D. flavescens* belong to that plant as here understood, although it must not be expected that when in fruit the peristome will necessarily be found to differ from that of *D. pellucidum*. As a matter of fact, out of many scores of gatherings with the "*flavescens*" characters of leaf, I have only seen two or three plants with the peristome as described by Lindberg, the great majority of course being barren. It is not an uncommon plant beside mountain streams, but the fruit is rare; when present, too, it is often overtopped by the innovations, and so rendered inconspicuous, in both species.

On account of the foregoing facts it appears better to sink *D. flavescens* to the rank of a sub-species.

Tribe 4. Trematodonteae.

20. **TREMATODON** Michx.

Plants with short stems, but tall fruitstalks. Leaves *very narrow, subulate, smooth;* cells rather lax, hexagonal-rectangular. Perichaetial bracts distinct. Calyptra inflated below, rostrate. Capsule on a long seta, oblong or cylindrical, cernous, *with a straight or curved neck, its own length or longer*. Peristome teeth 16 (rarely almost wanting), sub-entire, or more or less deeply divided into two unequal, papillose segments, which are usually somewhat united above, here and there perforate.

Besides the present one, the Tribe includes the genus Bruchia, with cleistocarpous, long-necked capsules.

DERIV.—τρηματο-(trēmato) perforated, and ὀδους (odous) a tooth; referring to the peristome teeth.

1. Trematodon ambiguus Hornsch. (*Dicranum ambiguum* Hedw.) (Tab. X. G.).

Densely tufted, pale green or brownish. Stems *short*, less than ½-inch high, slightly branched. Leaves erecto-patent, flexuose, from an *ovate-oblong concave base suddenly subulate-setaceous*, channelled, faintly denticulate at the extreme apex.

Nerve narrow, reaching to apex. Cells long, lax, hexagonal-rectangular and empty at base, quickly narrowing above and becoming irregularly quadrate in the subula, where they form a very narrow margin, and are small, chlorophyllose and obscure, becoming still more so at the apex, where they are hardly distinct from the nerve, which is not, however, strictly excurrent, or only rarely very slightly so. Perichaetial bracts much larger, more gradually acuminate. Seta variable in length in the same tuft, $\frac{1}{2}$–$1\frac{1}{2}$ *inches long*, flexuose, *straw-coloured*, shining; capsule (with the neck) clavate, arcuate, bright orange red; the capsule itself oblong or shortly cylindric, *with a long neck equal to itself*, which narrows gradually into the seta on the outer, convex side, or back of the fruit, but at the base on the front or inner side ceases abruptly and gives the appearance of a struma. Annulus broad; lid subulate-rostrate; teeth confluent at base on a short membrane, irregularly perforated and divided, sometimes cleft to base. Autoicous; male flower on a basal branch, terminal. Spores large, granulose.

Hab. Bare turfy places in subalpine districts. Extremely rare. Perthshire. Fr. late summer.

Only a single tuft of this beautiful moss has been found in Britain, by Braithwaite and Crombie, in 1883, at the base of Schiehallion. It is not very rare on the continent, and is frequent in N. America. Two other species are found in Europe, distinguished chiefly by the relative length and the form of the neck of the fruit. The long inflated neck gives the fruit a very peculiar appearance, and is totally different from anything else in this Order, and indeed more resembles that of some species of Meesia or Webera, but only superficially. The inequality of the base of the neck is not very obvious until the fruit is ripe, but is of importance in distinguishing *T. ambiguus* from other species of the genus.

Tribe 5. Dicranelleae.

21. **DICRANELLA** Schp.

The characters are those of the Tribe (*v.* p. 53). The small size and narrow silky leaves of most of the species, with capsules manifesting a somewhat uniform and distinct appearance of their own, renders this a well-marked genus. *D. squarrosa* alone of the British species widely diverges from the usual habit, but it is a plant which once known will not easily be forgotten; and the identification of the others is rendered the more easy from the fact that the greater number of the species are usually found in fruit, and those which are most likely to be found barren are the ones in which the vegetative characters are the most distinctive. All the species are dioicous except *D. crispa*, which is both dioicous and autoicous.

I have not followed Braithwaite in adopting Mitten's division into the two genera, Dicranella and Anisothecium, chiefly because the distinctive characters are hardly constant enough to be quite satisfactory, or clearly enough marked to be of much practical value to the student. Thus, *D. cerviculata* has the capsule smooth; on the other hand, in *D.* (Anisothecium) *Grevilleana* it is slightly striate; while with regard to the nerve at base, there is practically no difference between, for instance, that of some forms of *D. heteromalla* and *D.* (Anisothecium) *varia*.

DERIV.—Diminutive of Dicranum.

1 { Seta yellow; nerve very wide at base.....2
  { Seta red; nerve narrow.....3

2 { Capsule strumose at neck.....*2. cerviculata*
  { Capsule not strumose, sulcate, with incurved mouth when dry *1. heteromalla*

3 { Leaves more or less squarrose, from a sheathing base.....4
  { Leaves erect or secund, base scarcely sheathing 7

4 { Leaves oblong-lanceolate, very obtuse.....*9. squarrosa*
  { Leaves narrow-lanceolate or subulate.....5

5 { Capsule erect, striate, furrowed when dry.....*3. crispa*
  { Capsule cernuous, smooth or substriate only.....6

6 { Leaves entire; capsule faintly striate when dry.....*7. Grevilleana*
  { Leaves serrulate above; capsule smooth.....*8. Schreberi*

7 { Capsule striate, furrowed when dry.....8
  { Capsule smooth.....9

8 { Leaves entire; capsule subcernuous.....*4. secunda*
  { Leaves with a few teeth at apex; capsule erect.....*4*. curvata*

9 { Leaves entire, cells narrow; capsule cernuous.....*6. varia*
  { Leaves serrulate above, cells larger; capsule suberect.....*5. rufescens*

1. Dicranella heteromalla Schp. (*Bryum heteromallum* Dill.; *Dicranella fusco-rufa* Stirt. in Ann. Scot. Nat. Hist., xv, 108) (Tab. X. H.).

In dense silky bright yellowish or dark green tufts or sheets pale below, ½–2 inches high. Stems simple or forked, *leaves falcato-secund, the upper hamate*, more rarely erecto-patent; *gradually narrowed upwards from the point of insertion*, so that the lower part of the leaf has a narrowly triangular form; rarely with a slightly more distinct, somewhat concave leaf-base; upper part of leaf subulate, channelled, *faintly or sharply denticulate at margin and back from the middle upward*; rarely entire to near the apex, with a few teeth at the point; margin plane. Nerve ⅕–⅓ width of leaf at base, broad above and occupying the greater part of the subula, usually with a very narrow margin of cells reaching nearly or quite to the apex, but often excurrent in a denticulate point. Cells at base rectangular, *2–6 times as long as broad, shortly rectangular above* with the end walls oblique. Perichaetial bracts sheathing. Seta *pale yellow*, flexuose, ½–1 inch long;

capsule elliptical-oblong, inclined, slightly curved, glossy brown, smooth or very faintly striate; when dry and empty *deeply and widely plicate*, constricted below the mouth in front, with the mouth oblique and incurved, neck indistinct, gradually tapering, *not strumose*. Lid subulate-rostrate, curved downwards. Peristome large, teeth red, cleft to middle into two or three divisions. Male plant smaller, leaves less falcate, forming a terminal coma enclosing the inflorescence.

Var. β. *stricta* B. & S. Leaves *erecto-patent, straight;* seta longer, flexuose.

Var. γ. *interrupta* B. & S. (*Dicranum interruptum* Hedw.). Stem *taller, 1–2 inches*, more branched; leaves *sometimes in interrupted tufts*, patent or falcato-secund.

Var. δ. *sericea* Schp. Short, in dense, *bright green or yellowish, soft, silky tufts*. Leaves delicate, closer, *narrower*, erecto-patent or subsecund.

HAB. Banks in woods, roadsides, sandy hollows, etc., very common. The vars. β and γ rare. The var. δ on sandstone rocks, almost always barren, rare. Fr. winter.

The commonest of our species and one of the most variable, but with a peculiar habit which usually permits of its easy recognition. The empty capsule especially is very distinct in its glossy surface with somewhat oblique furrows and in its tapering neck and very oblique mouth: the yellow seta, too, distinguishes it at sight from all but the next species; it must be borne in mind that *old* capsules have the seta blackish, as they themselves also become. Occasionally, especially in mountainous districts, forms occur having the capsule very short, gibbous and rounded, and almost smooth as in *D. cerviculata*, differing, however, in the non-strumose neck; the seta also is shorter, less slender, and often slightly darker in colour. In these cases it may be taken at first sight for *D. secunda*.

The var. *sericea* is an exceedingly pretty and distinct form, and bears some superficial resemblance to forms of *Blindia acuta*, with which, it would seem, it has sometimes been confused.

The male inflorescence in this species, as in *D. rufescens* also, is oval and conspicuous, so large, indeed, that to the naked eye it often bears a resemblance to the fruit of a Pleuridium, and the plant is not unfrequently mistaken for a species of that genus.

Var. *orthocarpa* Hedw., with erect, symmetrical capsules, is a well-marked variety in North America. I have seen British plants with capsules that might be referred to the variety, but they have always been accompanied by intermediate forms.

2. Dicranella cerviculata Schp. (*Dicranum cerviculatum* Hedw.) (Tab. X. I.).

Smaller in all its parts than the last species, which it much resembles; yellowish green, *short;* leaves less falcate, *with a more distinct half-sheathing leaf-base*, more abruptly narrowed into the limb, less sharply denticulate and *often nearly entire above;* nerve very broad; cells longer and narrower, *6–10 times as long as broad at base, narrow and elongate above*. Seta shorter,

capsule *smaller*, more swollen and arcuate, gibbous, *with a distinctly strumose neck ;* smooth, very faintly and irregularly plicate when dry and empty.

Var. *β. pusilla* Schp. (*Dicranum pusillum* Hedw.) *Shorter*, leaves smaller, suberect ; capsule *smaller, less gibbous.*

HAB. Peaty banks and sides of ditches. Not uncommon. The var. *β* in similar localities and sometimes with the type ; rare. Fr. summer, rarely winter.

A species quite distinct in its short, curved capsule with a distinct struma, and yellow seta.

3. Dicranella crispa Schp. (*Dicranum crispum* Ehrh.) (Tab. X. J.).

In small, loose tufts, yellowish ; stems short (¼ inch) ; leaves *flexuose-squarrose*, slightly crisped when dry, from a *broad sub-sheathing base abruptly narrowed* to a long flexuose subula, minutely denticulate at apex ; nerve narrow, not excurrent ; cells all rectangular, narrow above, at base wider, 4–8 times as long as broad. Capsule small, *erect, symmetrical*, obovate, *distinctly and regularly striate*, when dry and empty somewhat urceolate, on a reddish seta ; lid with a straight or slightly curved subulate beak. Annulus separating in fragments. Male inflorescence on a separate branch or a different plant.

HAB. Wet sandy ground ; rare. Fr. late summer.

A rare species, readily known by its erect, symmetrical, striate capsule, and its leaves suddenly dilated and sheathing at base, with narrow cells compared with the other species having a similar leaf-base.

4. Dicranella secunda Lindb. (*Dicranum secundum* Swartz ; *Dicranella subulata* Schp. Syn., et plur. auct.) (Tab. X. K.).

In small silky tufts, about half-an-inch high. Leaves from an oval or oblong sub-sheathing base rather quickly narrowed to a long subula which is extremely fine above, *entire ;* nerve thin, narrow, excurrent ; cells narrowly rectangular at base, 5–8 times as long as broad, narrow-linear above. Perichaetial bracts *convolute and longly sheathing at base.* Seta about half-an-inch long, red ; capsule red, *subcernuous, slightly curved and gibbous*, with the mouth oblique and incurved, faintly striate, obscurely sulcate when dry. Lid long-beaked.

HAB. Stony ground on mountain sides. Not common. Fr. late summer.

Distinguished from *D. heteromalla* by the red seta, from *D. Grevilleana* by the longer capsule and differently-shaped leaves, from *D. varia* by the plane margin, from *D. rufescens* by the entire leaves. From *D. curvata* it differs as described under that plant.

*** Dicranella curvata** Schp. (*Dicranum curvatum* Hedw.) (Tab. XI. A.).

Much resembling *D. secunda*, and differing chiefly in the characters following, viz., the leaves with *a few minute denticulations* at apex, the *perichaetial bracts only half embracing* the seta, the capsule narrower, *erect and symmetrical or nearly so, deep red*, narrow-oblong when empty, and distinctly striate, on a rather shorter seta. The stems are also sometimes rather elongate, and occasionally longer than the seta, so that the capsule is hidden in the leaves; and the leaf base is slightly shorter.

Hab. Wet sandstone rocks and banks. Rare. Fr. late summer and autumn.

Specimens which have recently come under my notice incline me to agree with Limpricht, who attributes but slight value to the characters separating *D. secunda* and *D. curvata*. For instance, a plant sent by Mr. J. H. Davies from Colin Mt., Antrim, while clearly *D. secunda* in capsule and perichaetial bracts, has the leaves distinctly (though minutely) denticulate at apex. Other plants show that the degree of convolution in the perichaetial bracts is not a very reliable character. A plant gathered near the summit of Meall nan Tarmachan, Perthshire, moreover, with the capsule erect or very nearly so, has the leaves almost without denticulations, and the perichaetial bracts almost convolute. A similar plant is described by Thériot (Rev. Bry. 1896, p. 3), as *forma orthocarpa*, differing from *D. curvata* only in the perichaetial bracts. I have, therefore, reduced *D. curvata* to a sub-species of *D. secunda*.

As a rule, the erect, symmetrical capsule and denticulate leaf-apex will serve to distinguish it without much difficulty. The leaves at once separate it from *D. crispa*.

5. Dicranella rufescens Schp. (*Bryum rufescens* Dicks.; *Anisothecium rufescens* Lindb., Braithw. Br. M. Fl.) (Tab. XI. B.).

In small, short, dense tufts, yellowish green or more frequently *reddish*; stems slender, simple. Leaves *small, pellucid, without a distinct base*, gradually narrowed upwards, loosely placed, larger and more crowded above and secund, slightly flexuose when dry; nerve narrow, reaching to apex but not excurrent; *margin plane, remotely and bluntly denticulate in the upper half; cells larger* than in any of the previous species, with thinner walls, at base elongate-rectangular or sometimes prosenchymatous with oblique end walls, 6–8 times as long as broad, or longer, above similar, but rather narrower, occasionally rhomboid. Seta thin, red, short, *twisting to the left when dry*; capsule very small, *erect or very slightly inclined*, shortly elliptical, tapering at base, wide-mouthed when empty, *smooth*; lid acutely conical or rostellate. Peristome large, red; teeth spreading when dry.

Hab. Wet clay and bare ground in woods, etc. Fr. autumn.

The smallest British species, usually recognised by its vinous red tint, and always turning red in drying. The plane-margined denticulate leaves

distinguish it from *D. varia*, which almost always, also, has the capsule inclined. The pellucid leaves and smooth erect wide-mouthed capsule easily separate it from *D. curvata* and others of the genus. The same remark applies to this plant, with regard to the male inflorescence, as was made under *D. heteromalla*.

6. Dicranella varia Schp. (*Dicranum varium* Hedw. ; *Anisothecium rubrum* Lindb., Braithw. Br. M. Fl.) (Tab. XI. C.).

Densely gregarious or tufted, *bright or yellowish green ;* stems short, divided below. Leaves resembling those of the last species, but hardly secund, larger, *with the margin narrowly revolute, quite entire or faintly sinuose-denticulate at apex ;* cells similar in shape, but *smaller and narrower*, especially the upper ones. Capsule larger, on a longer seta, *twisting to the right, cernuous*, ovate or oblong, curved, finally contracted below the wide mouth, smooth ; lid large, rostellate ; peristome large, purple, teeth incurved when dry.

Var. β. *tenuifolia* B. & S. (*Dicranum tenuifolium* Bruch). Leaves more distant, *longer*, narrower, *nerve thin and indistinct, areolation lax ; margin denticulate above.*

Var. γ. *tenella* B. & S. *Slender ;* leaves usually falcate, *narrower*, areolation thin-walled, *laxer*, margin hardly recurved, remotely denticulate.

Var. δ. *callistoma* B. & S. (*Bryum callistomum* Dicks.) *Stem branched ;* seta short, *capsule minute, erect*, obovate, truncate ; lid widely conical, almost as large as capsule.

HAB. Damp clay fields, woods, etc. Common. The vars. rare. The var. δ in more mountainous districts. Fr. autumn and winter.

A very variable species, as its name implies, especially in size, and in the form of the capsule. Some of the varietal forms, *e.g.*, var. *tenella*, resemble the previous species, but that is a more delicate moss, and the capsule is different, as also the colour of the plant. *D. varia* usually has the leaves bright green and the seta and capsules deep red. The smooth capsule and the different form and texture of the leaves will serve to distinguish it from the other species.

The var. β has somewhat the same relationship to the type as the var. *elata* bears to *D. Schreberi ;* I have found both these varieties growing together, in wet spots, and probably excess of moisture has something to do with the variation in question.

7. Dicranella Grevilleana Schp. (*Dicranum Grevilleanum* B. & S. ; *Anisothecium Grevillei* Lindb., Braithw. Br. M. Fl.) (Tab. XI. D.).

Nearly allied to *D. Schreberi*. Plants of a more shining yellowish green, about a quarter of an inch high or rather more ; leaves from a rather wider sheathing base, more abruptly

contracted into a *narrower* flexuose subula, which is *quite entire or only very faintly denticulate at apex;* cells *rather narrower, firmer.* Capsule shorter, *very faintly striated when dry*, with a short indistinctly swollen neck; lid variable in length, shortly rostellate or subulate-rostrate from a conical base. Annulus persistent. Dioicous or more rarely autoicous.

Hab. Damp earth in mountainous regions. Very rare. Glen Tilt; Glen Shee; Ben Lawers; Ireland. Fr. summer.

The differences between this and the next species are very slight; the one, however, is an alpine plant, the other an inhabitant of the lowlands. From an examination of a limited number of specimens I am inclined to believe that the colour of the capsule, dull brown in *D. Schreberi*, bright glossy brown in the present plant, is a distinguishing character. The almost entire margin and narrower areolation of the leaves, together with the cernuous, faintly striate capsule, will serve to distinguish it from *D. crispa*.

8. Dicranella Schreberi Schp. (*Dicranum Schreberi* Swartz; *Anisothecium crispum* Lindb., Braithw. Br. M. Fl.) (Tab. XI. E.).

Tufts bright or yellowish-green, ½–1 inch high. Leaves from *a broad, half-sheathing base rapidly contracted into a lanceolate-subulate limb, squarrose,* not glossy, *irregularly denticulate throughout the greater part of its length,* nerve narrow, reaching to the somewhat broad apex; areolation at base rectangular, rather lax and pellucid, 4–6 times as long as broad, becoming shorter upwards, at the shoulder quadrate, in the limb shortly rectangular or narrowly hexagono-rectangular. Capsule cernuous, oblong, slightly curved, *smooth*, finally constricted in front a little below the mouth, lid large, *rostrate*.

Var. *β. elata* Schp. Closely tufted, *taller*, bright green; leaves *with a broader subula, more obtuse* and *more distinctly serrated* at apex, cells *larger*, wider.

Hab. Sides of ditches, etc., on clay soil. Not common. The var. *β* in similar or somewhat damper situations. Fr. autumn and spring.

D. Schreberi in its more luxuriant forms resembles the next species in miniature, but with very much narrower leaves; their squarrose direction from the broad, amplexicaul, erect base gives the stem a curious and characteristic appearance. The var. *elata* in its extreme forms differs greatly in appearance and leaf structure from the type, the cells especially being much larger, but intermediate links are often found, and it is frequently difficult to say to which of the two forms such specimens should be referred. The fruit, in the variety, is of rare occurrence.

D. Schreberi differs, when barren, from *D. crispa* and *D. Grevilleana*, in the larger, wider areolation; from *Ditrichum tenuifolium*, as remarked under that plant, in the larger less obscure cells and smoother leaf point.

9. Dicranella squarrosa Schp. (*Dicranum squarrosum* Schrad.; *Anisothecium squarrosum* Lindb., Braithw. Br. M. Fl.) (Tab. XI. F.).

Very *robust and tall*, 1–4 inches, densely tufted, *bright pale green;* stem slightly branched, stout. Leaves *large*, distant, flaccid, flexuose when dry, *squarrose* from a broad, oblong, erect, sheathing base, gradually narrowed to the broadly oblong-lanceolate channelled limb, which is *rounded and obtuse at apex, or obtusely pointed;* margin faintly sinuose, crenulate at apex; nerve very narrow, distinct, ceasing below the apex; *cells larger than in the other species*, very similar to those of the last, but larger, with thicker walls, more irregularly rectangular above, sometimes slightly elliptical or rhomboid, elongated at base, with a distinct sinuose "primordial utricle." Capsule on a long, stout seta, inclined, ovate, solid, smooth; *lid conical*, obtusely pointed.

HAB. By streams and in moorland bogs in subalpine regions; frequent but rare in fruit. Fr. autumn.

A very beautiful and conspicuous plant when growing, usually contrasting strikingly with the surrounding vegetation by its vivid yellow-green colour, and quite distinct from any other species of this genus; perhaps the plant most resembling it is *Dichodontium pellucidum*, which is, however, of a duller green, with highly papillose cells and denticulate leaves. The fruiting plant is smaller, and much less common.

Tribe 6. Dicraneae.

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22. BLINDIA B. & S.

Plants growing on mountain rocks, caespitose; leaves rigid, lanceolate-subulate, smooth, with distinct, coloured angular cells. Capsule *oval or subspherical, symmetrical*, thick-walled. Peristome *wanting or of 16 small, smooth teeth, not or very slightly cleft*, sometimes perforated.

DERIV.—After Pastor Blind, of the Vosges.

{ Plant minute; capsule immersed, gymnostomous.....*1. caespiticia*
{ Plant ½–4 inches; capsule exserted, peristomate.....*2. acuta*

1. Blindia caespiticia Lindb. (*Anoectangium caespiticium* Schwaeg.; *Stylostegium caespiticium* B. & S., Schp. Syn.) (Tab. XI. G.).

Dwarf, rigid, tufted, ¼–½ *inch high*, yellowish. Leaves small, crowded, erect, the apical slightly secund; scarcely altered when dry; from an oblong base about half the length of the leaf contracted to a narrow, subulate, almost terete point, composed entirely for the greater part of its length of the nerve, which is

very narrow at base, but widens considerably upwards and becomes obscure; margin plane, *quite entire*; cells of leaf-base linear-oblong with rounded ends, incrassate, narrowest below and at the margins, gradually shorter upwards, so as to be elliptical or oblong-elliptical at the shoulder and in the narrow margin of the lower part of the subula: at the angles large, quadrate, inflated, hyaline in the younger leaves, rich orange brown in the older: one or two cells at the acute apex of the leaf occasionally somewhat hyaline. Perichaetial bracts longer, sheathing. Capsule *immersed*, often appearing laterally from between the perichaetial bracts, subspherical, finally wide-mouthed, *[illegible]*; calyptra short, hardly reaching below the lid, which is obliquely rostellate, and united with the columella. Autoicous.

HAB. Crevices of mountain rocks; very rare. Ben Lawers. Fr. late summer.

A miniature of the next species as regards habit and leaf-structure, and not easy, in the barren state, to separate from starved alpine specimens of that plant; such specimens are, however, rare, and there is generally a slight denticulation of the point in *Blindia acuta*, which is almost always absent in the smaller species: the areolation also is shorter, and as *B. magellanica* is an autoicous species, the fruit is usually to be found. In some respects it resembles *Zygodon lapponicus*, which, however, is easily recognisable by its striated capsule, and the leaves crisped when dry. *Grimmia alpestris* too, and the var. *gracilis* of *G. apocarpa* which inhabit the same localities, have a certain resemblance: but they have broader leaves, which generally show more distinct points; under the microscope, of course the resemblance vanishes.

2. Blindia acuta B. & S. (*Bryum acutum* Huds.) Tab. XI. H.

In compact yellowish or olive green tufts varying greatly in length, *from ½ an inch to 4 inches* high: stems fragile, red. Leaves crowded, erecto-patent or slightly secund, convolute-concave, usually from an oblong-lanceolate base about ⅔ the length of the leaf gradually narrowed upwards to a subulate point, composed in the upper third of the excurrent nerve, which is generally rather rounded-obtuse at apex *with a few obscure denticulations* and short, irregular cells. Margin plane, slightly denticulate with the projecting apices of the outer cells or entire: areolation longer than in the last species, frequently with a slight sigmoid curve, the cell-walls often becoming very incrassate in the older leaves, rendering the cells very narrowly linear: angular cells large, orange brown. Capsule on a longer seta, *exserted* though often hidden by the leaves of the innovations, variable in shape, longly or shortly oval-pyriform, with a short, wide neck, slightly contracted below the mouth when empty, so as to appear urceolate; *peristomate*. Lid shortly and obliquely rostrate: peristome teeth broad, deep red, erect or incurved when dry. Dioicous.

Var. *β. trichodes* Braithw. (*Dicranum trichodes* Wils. MS.). Leaves more secund, from a *much shorter* leaf-base, ⅓–½ length of

leaf, *abruptly narrowed* into the long, very narrow, finely acute, denticulate subula, entirely composed of the nerve, slightly denticulate or entire at apex, where the cells are most frequently elongate-linear, angular cells fewer; capsule shorter, peristome teeth *short, truncate.*

HAB. Mountain rocks, especially near water, common; the var. β on rocks by waterfalls, etc., rare. Fr. summer.

A somewhat variable plant in the relative size of its parts, but always identified at once by the rigid, subulate leaves with deep orange basal angular cells; there is a peculiar habit which after a little practice makes it an easy plant to recognise in the field, but this is not easily described; it is partly due to the somewhat rigid, glossy, not at all flexuose leaves, smaller and shorter for the size of the plant than in most species of Campylopus and Dicranum.

The position and limits of the var. *trichodes* are very difficult to define. In Wilson's original specimens the apex of the subula is quite different in areolation from ordinary *B. acuta*, the cells being very long and narrow, and in only one or two rows at the tip, which is consequently very acute; whereas in *B. acuta* the apex is more or less wide and rounded, with short, irregular cells, and with crowded denticulations, and even when, as occasionally happens, it is very acute, the areolation is still the same. If this be held a distinguishing character, then the greater number of specimens labelled "*B. trichodes*" must certainly be referred to the type, including for instance Nowell's plant from Todmorden, specimens of which I have, through the kindness of Dr. Braithwaite, in my herbarium. In this case it will be probably found that the true var. *trichodes* is always a very small plant, as described by Philibert (*Rev. Bry.*, 1884, p. 90). I have gathered this form barren on the Sow of Athol, Perthshire, and the greater number of the leaves show exactly the characteristic areolation of Wilson's plant; though a few leaves show some approach to the normal *acuta* form. I have, however, found in more than one case, especially in a plant sent by Mr. Jas. Needham from near Hebden Bridge, both forms of apical areolation on leaves from the same stem, while the leaf form was characteristic of the var. *trichodes*. We must therefore leave the apical areolation out of the question and then we can set hardly any satisfactory limits to the variety; for forms of *Blindia acuta* are very frequent (especially on rocks constantly exposed to the action of water, as beneath waterfalls) which show the form of leaf exactly characteristic of "*trichodes*," but with the apical areolation, and the fruit of *B. acuta*. It seems best, therefore, to base the variety upon the form of leaf, while recognising that it is an unsatisfactory one.

23. DICRANOWEISIA Lindb.

Plants in dense cushions; leaves *crisped when dry, entire,* with the angular cells more or less distinct. Capsule *erect, smooth;* peristome teeth cleft at apex or undivided, articulated and internally barred.

The two species of this genus are closely allied to Cynodontium, especially to *C. Bruntoni*, but the presence of distinct angular cells, in *D. crispula* particularly, is sufficient to justify the present arrangement.

DERIV.—Compound of Dicranum and Weisia.

{ Leaves with narrow, acute points; capsule oval-elliptic.....*2. crispula*
{ Leaves with shorter, subacute points; capsule cylindric.....*1. cirrata*

1. Dicranoweisia cirrata Lindb. (*Mnium cirrhatum* L. ; *Weisia cirrhata* Hedw., plur. auct. ; *Dicranoweisia Sutherlandii* Stirt. in Ann. Scot. Nat. Hist. xviii, 168.) (Tab. XI. I.).

Plants in close tufts or cushions, soft, dull or yellowish green, about 1 inch high. Leaves spreading, flexuose, closely crisped when dry, concave, deeply channelled on the upper side of the nerve, from a lanceolate base linear-lanceolate, *gradually narrowed to a not very acute point ; margin recurved*, especially in the middle of the leaf, entire ; nerve reaching to apex, but not excurrent. Upper cells small, regularly rounded-quadrate, *smooth*, below gradually becoming rectangular, larger, at base pellucid, broadly rectangular, lax, with thin walls ; two or three rows of basal cells often coloured yellowish, but *hardly otherwise distinct*. Inner perichaetial bracts sheathing to about the middle. Capsule on a pale seta ($\frac{1}{4}$–$\frac{1}{2}$ inch long), erect, *cylindrical*, pale, with a *narrow* red mouth, smooth, thin-walled ; calyptra narrow, shining ; lid obliquely subulate-rostrate, long ; *annulus broad*. Peristome teeth undivided, red below, pale above, inserted below the mouth. Autoicous.

Hab. On trees, fences and thatch, sometimes on rocks ; common. Fr. winter.

Usually in small compact cushions and abundantly fertile. The capsule is sometimes very slightly curved. The entire leaves, smooth cells, and narrow capsule distinguish this plant from *Cynodontium Bruntoni ;* the shorter seta, longer and narrower capsule, and revolute leaf margin separate it from the next species, the lower cells also are smaller. I have, however, a plant from Mr. W. Evans gathered on rocks on the Braid Hills near Edinburgh, with the capsule of exactly the same shape and colour as that of *D. crispula*, while the leaves show it to belong here. Such forms, however, are extremely rare.

Our plant has also some resemblance to *Dicranum montanum*, but the leaves of the latter will be seen even with a lens to be very rough and denticulate in the subula.

2. Dicranoweisia crispula Lindb. *Weisia crispula* Hedw., plur. auct. ; *Dicranum leiophyllum* Stirt. in Ann. Scot. Nat. Hist. xvi, 178.) (Tab. XI. J.).

In dense cushions, bright or dark green above, black below. Leaves spreading, often secund above, strongly crisped when dry, longer, from a broader base *more quickly narrowed to a longer, narrower*, flexuose, concave subula, *acute at apex ; margin plane*, quite entire ; cells mamillately papillose above, resembling the last, but *smaller*, more incrassate, narrower below and less pellucid, *with distinct hyaline or coloured inflated angular cells*. Perichaetial bracts more distinct, pale, sheathing to near apex. Capsule on a *longer* seta ($\frac{1}{2}$–$\frac{3}{4}$ inch), *oval-elliptical, shorter and wider*, broadest near the base, with a *wider* mouth, reddish brown,

faintly plicate-rugose when dry, *exannulate*. Peristome teeth inserted below the mouth. Autoicous.

HAB. Mountain rocks ; not common. Fr. early summer.

On high mountains this species becomes almost black ; and at great heights, when exposed to dripping water, it becomes dwarfed, with shorter leaves and capsules (var. *atrata* N. & H.). *D. compacta* (Schleich.), which is often regarded as a variety of this species, has been recorded from Ben Lawers, but incorrectly, according to Braithwaite. It has shorter, more obtuse leaves, hardly crisped when dry.

D. crispula will easily be distinguished from *D. cirrata* by the characters italicised above. *Grimmia contorta* closely resembles it when growing, but the present plant is usually taller, a little more glossy in its leaves, which are often secund above when moist, rather more twisted and curled when dry, and, of course, entirely wanting in the hyaline tip to the leaves. Still, plants may be found which defy recognition until placed under the microscope, when their identification is easy.

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24. CAMPYLOPUS Brid.

Mosses of varying size, often robust, usually growing in wide patches, resembling Dicranum in habit, but with the leaves more rigid, less flexuose, and *generally straight ;* not papillose ; *nerve mostly very broad*, often longitudinally furrowed at back, usually with one or more layers of larger, hyaline, thin-walled cells on the *anterior* or ventral surface. Angular cells often forming distinct concave auricles. Calyptra cucullate, *generally fringed at base. Seta flexuose, usually cygneous*, rarely erect (becoming erect when dry and mature) ; capsule small, *elliptic, symmetrical*, usually striate ; peristome dicranoid.

All the British species are dioicous, and the fruit in most cases is extremely rare ; hence their determination must rest mainly on vegetative characters. The width of the nerve and its structure for the most part furnish important distinctions, as does also the basal areolation ; the cells in the upper part of the leaf, however, are too uniform to be of much aid, except in one or two cases. These islands are particularly rich in species of this genus, more so than any continental country ; indeed, all the European species are found in Britain, while two of our species are endemic. In several of the species the leaves are extremely fragile and deciduous, and, being capable of producing outgrowths in the form of protonemoid filaments, afford a means of propagating the species. The measurements of the width of the nerve are taken just above the auricles when these are present.

The number of layers of cells in the nerve as shewn in section is a character of slight value, as is also the presence or absence of furrows on the dorsal surface, except in the case of *C. introflexus ;* Limpricht has however pointed out two distinct types of structure in these cells which are quite constant, and by which the species may be divided into three groups ; (1) *C. brevipilus ;* unique in

having the single layer of wide thin-walled empty "guide-cells" *median*, with stereid-cells both above and below (Tab. XIII. B. 1x). (2) *C. subulatus, C. Schimperi, C. Schwarzii ;* in these the layers of thin-walled larger empty cells are *anterior*, consisting of a superficial ventral layer and a single median layer of "guide-cells," while the posterior layers are of small, *uniform*, moderately incrassate cells (Tab. XI. K. 1x). (3) All the remaining species have the same two *anterior* series of large thin-walled cells, but the dorsal layers are composed of *two* forms of cells, small groups of minute, *very* incrassate cells, almost without lumen ("stereid-cells"), being interspersed between the larger ones (Tab. XII. A. 1x).

DERIV.—*καμπυλο*-(kampylo) bent, and *πους* (pous) a foot ; from the cygneous seta.

1 { Leaves with hyaline points....2
  { Leaves without hyaline points....4

2 { Hyaline points short ; nerve with central large cells....*9. brevipilus*
  { Hyaline points usually long ; nerve with anterior layer of wide cells....3

3 { Ls. auricled, dark-green ; upper cells long and narrow....*7. atrovirens*
  { Ls. not auricled, olive-green ; upper cells short....*8. introflexus*

4 { Ls. not (or scarcely) auricled at base....5
  { Ls. auricled at base with swollen cells....8

5 { Ls. straight, almost entire ; cells near base very narrow....6
  { Ls. almost setaceous, serrulate towards apex ; basal cells lax....7

6 { Stem usually ½–1 inch, not radiculose....*1. subulatus*
  { Stem taller, densely tomentose....*1*. Schimperi*

7 { Nerve about ½ of base of leaf ; lamina usually widest at base....*3*. pyriformis*
  { Nerve about ½ base ; ls. from longer base, lamina narrowed at insertion....*4. fragilis*

8 { Ls. strongly serrate above ; stem tall, not radiculose....*6. setifolius*
  { Ls. entire, or serrulate near apex only....9

9 { Nerve ⅓–½ of base of leaf....*3. flexuosus*
  { Nerve ⅔ or more of base....10

10 { Ls. gradually tapering almost from base, entire....*2. Schwarzii*
   { Ls. with longer and wider base, more suddenly narrowed to the long subula, denticulate at apex....*5. Shawii*

1. Campylopus subulatus Schp. ex Milde in Rabenh. Bryoth. Eur. (*C. brevifolius* Schp. Syn. ; *C. fusco-luteus* Stirt. in Ann. Scot. Nat. Hist. vi, 117 ; *Dicranum expallidum* Stirt., op. cit., vi, 118.) (Tab. XI. K.).

Short and very slender, yellowish, resembling the small forms of *C. fragilis*, but with shorter, more rigid leaves ; stems slender, fragile, ¼–1 inch in height or at times taller, 1-2in., densely gregarious or loosely tufted, *not radiculose above* in the type. Leaves *short*, erect, *rigid*, from an oblong base *half the length of of the leaf*, narrowed, with the margins involute, to a straight short tubular subula, not hyaline pointed ; cells at angles vesicular,

hyaline, not much altered, rarely forming distinct, minute, slightly inflated auricles; *basal cells narrow*, rectangular, hyaline, very soon passing into the shorter obliquely rhomboid or sub-elliptical chlorophyllose cells which occupy the greater part of the lamina; a band of extremely narrow, thin, hyaline cells usually forms a narrow border to the leaf base for some distance higher than the hyaline cells extend in the interior of the leaf; towards the apex of the leaf the lamina consists of a single row of short oblique cells reaching very nearly to the summit, where, however, the nerve is very shortly excurrent with a few denticulations; at base the nerve is *very broad*, usually *nearly ⅔ the whole width*, and forming the greater part of the subula above; in section of about 4 layers of cells, two ventral layers usually large, thin-walled and hyaline; posterior layers of smaller, uniform cells, the alternate cells of the dorsal row usually projecting, owing to a slight longitudinal furrowing of the nerve at back. Seta erect, slightly bent in the middle, but not cygneous.

HAB. Dry sandy spots by roadsides, etc. Rare. Fruit extremely rare.

A pretty little species, known by its very slender habit and short leaves. The narrower hyaline cells at the base, extending only a short distance upwards, together with the much shorter, straight subula, will distinguish it from almost all forms of *C. fragilis* and *C. pyriformis*, both of which differ also in the nerve section. *C. Schwarzii* has the leaves distinctly auricled. The presence or absence of auricles in this as in some other species is a very uncertain character, some plants showing distinctly inflated tufts of angular cells, while in others they are barely distinguishable from the other basal cells. The nerve section, too, shows a considerable amount of variation in the number of layers and the protuberance of the dorsal cells. Indeed, it is a difficult plant to distinguish certainly from starved forms of several of the other species.

So many forms have been noted approaching var. *elongatus* Bosw. closely in height, that it seems impossible to retain it as a separate variety. The stems in this form may occasionally be radiculose in the lower part.

The fruit had only been gathered on the island of Varaldsö, in Norway, until in 1899 Prof. Barker gathered a tuft of it with several capsules in the R. Llugwy, N. Wales (cf. Rev. Bry. 1901, p. 13).

*** Campylopus Schimperi** Milde (Tab. XI. L.).

Differs from *C. subulatus* in the usually *taller*, more robust stems, with leaves more closely imbricated, the plants densely tufted and *usually interwoven to near the summit with brown radicles*, 1–3 inches high, usually bright green above, pale or brown below. Leaves much like those of the above species, but often longer, with a setaceous subula; basal cells very narrow, the angular vesicular, sometimes brown, and forming more or less distinct but minute auricles. Seta curved.

HAB. Earth and rocks on mountains. Rare.

All the above characters are more or less variable, and there is in fact very little to distinguish *C. Schimperi* specifically from *C. subulatus*. The more

robust habit and radiculose stems are the best characteristics, but the latter is by no means constant. Nor do I find that characteristics derived from the section of the nerve are of any more value.

On the other side *C. Schimperi* very nearly approaches *C. Schwarzii*, but is of smaller size, with less defined auricles.

The fruit has only been once recorded, in the Austrian Tyrol.

2. Campylopus Schwarzii Schp. (*C. purpurascens* Stirt. in. Ann. Scot. Nat. Hist. x, 109; *C. symplectus* Stirt. in Scot. Nat., No. xi, p. 234). (Tab. XII. A.).

In dense, silky tufts, 2–4 inches high, bright or yellowish green; stems more robust than in the species hitherto described, attenuated at the points, slightly radiculose. Leaves erecto-patent, *straight when dry* or slightly bent at apex, *gradually narrowed with incurved margin from near the base*, tubular, larger and longer than in *C. Schimperi*, entire or with one or two indistinct teeth at apex, not hyaline pointed. Nerve very broad, $\frac{2}{3}$–$\frac{3}{4}$ *width of leaf at base*, in section of 3–4 layers of cells, resembling those of the last species, *grooved at back above; auricles distinct, slightly dilated*, hyaline or red; cells of the leaf-base narrowly rectangular, very narrow at margin, above smaller, narrowly rectangular or subquadrate-elliptical. Fruit unknown.

Var. β. *Hunti* (*C. Hunti* Stirton, Ann. of Scot. Nat. Hist. 1899). Slender. Intermediate in habit between *C. Schwarzii* and *C. subulatus*. Nerve narrower, *half width of base*, in section of 4 rows of lax cells, which become *enlarged downwards, giving the nerve a spongy texture*. Auricles not highly developed. All cells at back of nerve (except at extreme base) and in upper part of lamina *shortly rectangular or quadrate, rather large, distinct, turgid.*

Hab. Alpine rocks; not common. The var. β Snowdon, 1865 (*G. F. Hunt*).

It is very difficult, if not impossible, to point out any important structural character in which this species differs from *C. Schimperi*, although the dense red tomentum of that species is rarely present in *C. Schwarzii*; its size and habit also preclude any great difficulty in distinguishing it. The presence of distinct auricles, slightly wider than the rest of the leaf base, is the feature commonly relied on; but forms of *C. Schimperi* show a distinct approach to this structure, although in a minor degree. The grooving of the nerve at back might also be pointed to, but this feature also exists in some forms at least of the other plant, which Braithwaite indeed describes as having the posterior cells of the nerve turgid and prominent. From *C. Shawii* it differs in the shorter leaf and leaf-base, with the nerve occupying a greater proportion of the width, and with shorter, almost perfectly entire points, and in the usually more attenuated, slender plants with more distant leaves.

The var. β was described by Hunt as between *C. fragilis* and *C. Schwarzii*. It is remarkable in its structure, and perhaps deserves the specific rank given it by Dr. Stirton, but the differences between it and *C. Schwarzii* are not really wide, and I think it is best treated as a variety.

3. Campylopus flexuosus Brid. (*Bryum flexuosum* L.; *Campylopus crenulatus* Stirt. in Trans. Bot. Soc. Edinb. xxvi, 244; *C. melaphanus* Stirt. in Ann. Scot. Nat. Hist. xii, 110; *C. subcinereus* Stirt. op. cit., viii, 105) (Tab. XII. B.).

Extremely variable in size, colour, and habit; ½–4 inches high; as slender as *C. subulatus*, or almost as tall and robust as *C. Shawii;* leaves straight, small and rigid, or long and secund, *often rather flexuose when dry*. Usually in rather dense tufts, *tomentose*. Leaves lanceolate-subulate from a *narrow, oblong base*, tubular above, the lower usually reddish at base; without a hyaline point; margin usually denticulate for some distance below the apex; nerve ⅛-½ *width of base*, cells of the two anterior layers larger, thin-walled, about equal, of posterior layers smaller, interspersed with groups of minute, very incrassate opaque stereid cells; arcolation rectangular and pellucid at base, with large, distinct, red, brown or hyaline auricles, cells above shortly rhomboid or oval. Capsules often aggregated, thick-walled, dark brown, furrowed.

Var. β. *uliginosus* Ren. *Tall and slender with fewer radicles, and less crowded leaves*, which are more elongated, with a narrower nerve.

Var. γ. *paradoxus* Husn. (*C. paradoxus* Wils.; *C. leucophaeus* Stirt. in Ann. Scot. Nat. Hist. xii., 110; *C. oltectus* Stirt. in Trans. Bot. Soc. Edinb. xxvi., 426; *C. rubiginosus* Stirt. in Ann. Scot. Nat. Hist. xv., 109). Shorter, softer; green above, whitish below; stems sparingly radiculose. *Leaves very short, with much broader somewhat obtuse points*, nerve narrow, *vanishing in apex*.

Var. δ. *zonatus* Limpr. (*C. zonatus* Mol.; var. *major* Boul.). Tall, robust, in habit like *Dicranodontium longirostre* var. *alpinum*. Stems covered with *red tomentum*. Leaves secund, large; nerve stout; auricles very *strongly developed and wide, purple red*.

HAB. On turfy ground in woods, and on rocks, common. The var. β in marshes; the var. γ on rocks and soil usually in subalpine districts; the var. δ on rocks in mountainous country, rare. Fr. winter and spring.

The commonest and most variable species, and difficult to define, though as a rule fairly easy of determination, the leaf-base, although variable, having a look of its own, perhaps chiefly arising from its narrow outline, with the nerve mostly narrower than in the allied species, and usually with distinct auricles. These are, however, occasionally almost obsolete, in which case we have a transition to the sub spec. *pyriformis*. The marsh form usually given in English books as var. *paludosus* Schp. would appear to be the same thing as the var. *uliginosus* Ren. (*Rev. Bry. 1887, p. 81*) and should be so cited. The var. *paradoxus* is in most works treated—though often doubtfully—as a species; there is little doubt that Braithwaite is right in finally sinking it to varietal rank. A tall green form occurs with a long denticulate arista, resembling *C. setifolius* and not easy to separate. The latter, however, is a finer plant, with wider nerve, more finely setaceous leaves and wider auricles.

The most frequent form has usually a bright reddish brown tint in the interior of the tufts, which is hardly found in the allied species.

* **Campylopus pyriformis** Brid. (*Dicranum pyriforme* Schultz; *C. turfaceus* B. & S., Schp. Syn.; *C. pergracilis* Stirt. in Ann. Scot. Nat. Hist. xiv., 105) (Tab. XII. C.).

In short dense wide patches, ½–1 *inch high*, yellowish or olive green above, pale or reddish below: *stems slender, radiculose only at base*. Upper leaves longest, from an ovate-lanceolate base, ¼–⅓ *length of leaf*, quickly narrowed to a setaceous channelled subula; nerve ⅛ ½ width of base, excurrent in a short denticulate point; in section similar to *C. flexuosus*; basal cells rectangular, *lax, hyaline*, narrower at margin, *the angular few, hardly distinct*; the cells as they ascend the leaf base become smaller and shorter, at the shoulder becoming chlorophyllose, shortly rhomboid and oblique or sub-rectangular, and continuing so, but smaller, to the summit. Calyptra fringed at the base or rarely entire. Capsule smaller, elliptical, cylindrical when dry and empty.

Hab. Peaty moorlands, heaths, etc., common. Fr. spring and summer.

I have, after much hesitation, followed Boulay (*Muscinées de la France, p. 511*) in placing this plant under *C. flexuosus*; for, distinct as is the habit in the typical and most frequent form, the distinguishing characters of real importance are slight, if not entirely wanting. The usual form of *C. pyriformis* described above is a much more slender and delicate plant than the ordinary forms of *C. flexuosus*, with much smaller leaves, hardly showing a trace of auricles; and it is probably the wide difference in general appearance that has caused the real affinity to be overlooked. On the other hand, *C. flexuosus* frequently presents forms quite as slender, and the leaves are sometimes quite as free from auricles, and I have found plants which I have been quite unable to refer with certainty to either species, leaves being found on the same plant with considerable variation as regards the development of the auricles, and intermediate between the two as regards the other characters. Indeed, both the width of the nerve and the form and areolation of the leaf-base vary greatly in both plants. Nor do the other characters, sometimes given, as for instance differences in nerve-section, appear constant; indeed, this latter structure, although of great value in separating certain of the species of Campylopus, does not appear to give characters of sufficient constancy to distinguish those which are closely allied.

In *C. pyriformis* the areolation of the leaf-base is usually hyaline for a greater distance upwards than in *C. flexuosus*, and this gives the leaf and indeed the whole stem a whitish appearance. On the other side this feature brings it nearer *C. fragilis*, from which it is sometimes with difficulty separated; but the lamina in that species is narrower at the line of insertion than above, while in this the leaf is usually widest at the very base; and the habit of *C. fragilis* is usually very different.

When fertile, the fruit is produced in abundance, and the leaves are then usually not very deciduous; but in barren plants the broken-off leaves often cover the whole surface of the tufts. The var. *Mœllleri* (*C. Mœllleri* Jur.) is only a form with the calyptra entire or very slightly fringed at base. I have found both forms on the same tuft.

Plants of *C. pyriformis* gathered by Mr. D. A. Jones in two or three localities in N. Wales have short hyaline points to some leaves. This may, perhaps, be discolouration due to scorching; it is liable to give rise to confusion, but is extremely rare, and the absence of auricles, together with the nerve section, will identify it.

4. Campylopus fragilis B. & S. (*Bryum fragile* Dicks.; *Campylopus citrescens* Stirt. in Trans. Bot. Soc. Edinb. xxvi., 245) (Tab. XII. D.).

Taller than *C. pyriformis* and usually more robust, 2 inches high, more radiculose, with longer, straighter, very silky leaves, less flexuose when dry; the colour of a brighter green, often yellowish, whitish below and shining from the hyaline leaf-bases. Frequently it becomes very densely tufted, when the stems are usually more robust, often two inches high, and the leaves broader, shorter, more rigid, more closely imbricated, very white and shining below. The leaves are *fragile and deciduous*, but not so generally as in *C. pyriformis*. The form of the leaf also is rather different, the leaf-base being somewhat *longer in proportion to the whole*, and the lamina is *narrowed at the base of the leaf*; nerve *broad*, $\frac{1}{2}$–$\frac{2}{3}$ *width of leaf at base*, in structure similar to that of *C. pyriformis*; *cells of base lax and hyaline*, the angular not or hardly distinct; upper cells, capsule, etc., as in that plant.

HAB. Turfy soil and rocks; frequent. Fr. rare; spring.

Best distinguished by the nerve section, the wide cells of the leaf-base, which separate it from *C. Schimperi* and *C. subulatus*, and the wider nerve and lamina contracted at the base, by which it is known from *C. pyriformis*. The compact forms with shorter leaves have been distinguished as a variety and even as a species under the name of *C. densus* B. & S., and they are markedly different from the typical form, but are connected with it by too many intermediate links to be separated. On the whole, the more robust habit and distinct appearance make this a species not difficult to recognise from *C. pyriformis*; and from most of its congeners it is usually distinguishable by its short, neat habit, and shining leaf-bases. It usually grows in smaller, neater tufts, and is more frequently found on rocks than most of the species.

5. Campylopus Shawii Wils. (Tab. XII. E.).

In tall, dense, slightly radiculose tufts, *2–4 inches high*, yellowish green or olive brown, dark brown below; plants *robust*, not much attenuated above, the leaves very large, *closely set*, erecto-patent or secund, slightly flexuose when dry, *larger and longer* than in *C. Schwarzii*, *from a much longer leaf-base*, quickly contracted to a *longer, much narrower, setaceous but not hyaline point, distinctly denticulate at apex*, with often a few denticulations for a little distance below, at back of nerve smooth or faintly muriculate, not denticulate; tubular with the margin incurved from near base or somewhat higher up; nerve *usually about* $\frac{2}{3}$ *the width of the base*, but somewhat variable, *smooth at back*; in section like *C. setifolius*. Cells at base rectangular, rather wide, quickly becoming rhomboid, above rhomboid with rounded angles, or oval; *auricles large, inflated*, hyaline or coloured, scarcely wider than the rest of the lamina. Fruit unknown.

Var. *β. hamatus* Schp. Leaves very densely imbricated, **broader**, *hamato-secund*.

HAB. Peat bogs and moors; Hebrides; Skye; Inverness; Ireland. The var. β in N. Uist and S.W. Ireland, with the type.

A fine species, resembling very robust forms of *C. Schwarzii*, and the denser and more compact forms of *C. setifolius*, to which it is the most closely allied in structural characters. *C. Schwarzii* has a shorter leaf base, not much more than half its length, while that of *C. Shawii* is much longer and more suddenly narrowed above; this leaf-base is very glossy and conspicuous and gives a distinct character to the plant in the dry state, which is shared by *C. setifolius*. The nerve is also somewhat wider in proportion to the leaf in *C. Schwarzii*, and the subula usually much shorter and less flexuose. The presence of stereid cells in the nerve in the present plant is an ultimate test, but they are frequently so few and inconspicuous that they may easily be overlooked. In general, however, the robust habit and large long leaves will distinguish *C. Shawii* from any form of *C. Schwarzii*. It is really closer to *C. setifolius*, and the denser forms of that species resemble it very closely indeed, but the subula, which is rarely very strongly toothed in *C. Shawii*, and is smooth at the back of the nerve, together with the less conspicuous auricles, will serve to distinguish the present plant. *C. setifolius* is also usually of a deeper, less yellowish green. I do not find the outer layer of colourless cells in the stem section which Limpricht describes as separating *C. Shawii* from *C. setifolius*; if at times present it is certainly not constant.

Some robust forms of *C. flexuosus* might be confused with *C. Shawii*, but the former species has narrower leaves with a narrower nerve, and in these forms the stems are usually very radiculose. In habit *C. Shawii* perhaps resembles most the robust alpine forms of *Dicranum Bonneani* and *D. fuscescens*; but the leaf structure is of course quite different.

This species, like *C. setifolius*, has not been found outside the British Isles.

As is the case with the analogous variety of *C. atrovirens*, the var. *hamatus* can scarcely be looked upon as a well established variety. Not only are stems with the typical foliation frequently found in the tufts with falcate leaves, but it not seldom happens that the lower leaves on a stem will be of the normal straight form, and those at the apex strongly and regularly falcate. When well marked, however, it is a beautiful form.

The var. *rufulus* Stirt. is a rather pretty colour form, but a form rather than a variety.

6. Campylopus setifolius Wils. (*C. porophorus* Stirt. in Ann. Scot. Nat. Hist. x., 113) (Tab. XII. F.).

In large, loose, bright glossy, deep or yellowish green tufts, dark brown below, *4-10 inches high*: rather slender, usually attenuated at point, radiculose only at base. Leaves *not crowded*, erecto patent, *not flexuose when dry*, shining, *very longly setaceous* from a wide base, tubular with the margin involute all its length, *denticulate-serrate in the upper part* for some distance below the apex, which is not hyaline; nerve broad, half the width of the base, excurrent, *spinosely denticulate at back above*; in section with the anterior row of large, pellucid, thin-walled cells, larger than those of the median row (guide-cells), the posterior layers of much smaller thicker-walled chlorophyllose cells, with groups, sometimes small and inconspicuous, of a few stereid-cells interspersed; angular cells large, forming *wide* inflated auricles, red or hyaline; above the auricles the cells are short, rectangular,

shortly rhomboid or elliptic; very small and rhomboid-elliptic in the upper part of the leaf. Capsules aggregated, ovate-pyriform, lid rostellate, half the length of the capsule.

Var. β. *intermedius* D. A. Jones in Journ. of Bot., 1917, p. 265. Leaves *less finely subulate*, less strongly toothed; nerve *narrower*, often less than half width of base; basal cells *laxer*, with thinner walls.

HAB. Rocks among grass and heather; very rare in England, Wales, and Scotland, less so in the west of Ireland. Endemic in Britain. Fruit very rare. The var. β very rare, Merioneth.

Another very fine and interesting species, hitherto unknown outside the British Isles. It is easily known by the wide auricles and the strongly hispid-denticulate, not hyaline, longly setaceous leaf-points.

The outer cells of the auricles are usually hyaline, the inner, together with the base of the nerve, deep orange red.

The broad shining leaf-bases are still more conspicuous in this species than in *C. Shawii* in the dry state, owing to the much laxer disposition of the leaves, and give a very characteristic appearance to the plant. Occasionally denser forms occur, with closer leaves, when the microscope is needed to determine the species with certainty.

The var. β is perplexingly intermediate betweeen *C. setifolius* and *C. flexuosus*, with which species it is indeed connected by intermediate forms. Certain characters, however, notably the habit and colour, and the nerve section, seem to indicate its relationship being closer with *C. setifolius*.

There is some resemblance between the leaves of this species and those of some of the species of Dicranum and of *Dicranodontium longirostre*; but the present is a more robust plant than most of these, with the leaves not falcato-secund; and in any case of difficulty it will be certainly dispelled with the microscope. those species at all resembling it in habit having always a much narrower nerve; *D. longirostre* var. *alpinum* is the only one about which confusion is really likely to arise, and this has the leaves less strongly denticulate above, and of a different form at the base, being more quickly narrowed and with the margin more strongly enrolled below, and the nerve narrower; the upper cells, too, are quite different.

7. Campylopus atrovirens De Not. (*C. longipilus* Brid., Schp. Syn.; *C. Fergussonii* Stirt. in Trans. Bot. Soc. Edinb. xxvi, 243; *C. perplexans* Stirt. op. cit., xxvi, 247) (Tab. XII. G.).

Tall, *2–8 inches high*, bright or dull green above, *black* or golden yellow below. Stem soft, very slender, hardly radiculose above, leaves rather laxly placed, long, straight, tubular above from an oblong-lanceolate base, margin entire, *nerve half width of base*, somewhat variable, excurrent in a *hoary, denticulate, very slender hyaline arista* of varying length; in section of about four rows of cells, median posterior cells mostly of the stereid form, the dorsal series larger, the alternate ones protruding, so that the leaf is grooved at back; auricles distinct, coloured, inflated; basal cells rectangular, quickly becoming obliquely rhomboid and elliptic, in all the upper part of the leaf *narrowly rhomboid, oblong or linear, vermicular.*

Var. β. *falcatus* Braithw. More robust, shorter; leaves *falcato-secund or regularly circinate.*

Var. γ. *muticus* Milde (var. *epilosus* Braithw., Handb. Ed. I.; *C. prasino-rufus* Stirt. in Ann. Scot. Nat. Hist. xv, 108). More slender; leaves shorter, *the hair-points almost entirely wanting.*

Var. δ. *gracilis* Dixon, Journ. of Bot. 1902, p. 374. *Extremely slender,* the shorter forms resembling *C. pyriformis*, 1-2½ inches high; bright or yellowish above, yellowish brown below, *not black;* densely tufted. Leaves often longer than in the type, but *much narrower, the subula and hyaline arista exceedingly slender;* upper cells *usually rhomboid, thin-walled.*

HAB. Rocks and bogs on moors and mountains. Sterile only. The var. β rare, in Western Ireland and Skye. The var. γ not common. The var. δ rare, N. Wales; Lake District; Scotland.

A handsome moss, almost always recognised at once by the blackish tinge which is mostly present in some degree and by the hoary leaf-points. These latter are variable in length, and are also very fragile; it sometimes happens, therefore, that they are inconspicuous and only to be found by careful search. They are not fully developed until the leaves are mature, hence in the youngest leaves of all they are short; however, they will usually be found most distinct in the upper leaves, as in the older ones they are frequently broken off. In the var. *muticus* the upper leaves show no trace of hyaline points, but are rounded-truncate and slightly cucullate at apex; a careful examination will, however, usually reveal a very short hair-point on some of the older leaves. I should refer to this variety the var *incurvatus* Stirt. (Ann. of Scot. Nat. Hist. 1901, p. 111). Milde's name, published in 1870, would appear to have priority over Braithwaite's, which dates from 1887.

The var. *falcatus* in its typical form is a very pretty plant, with its leaves beautifully circinate. Intermediate forms occur, but rarely.

The var. *gracilis* is exceedingly slender, and has none of the ordinary appearance of *C. strictus*. The details of leaf structure, however, agree, and intermediate forms are not wanting. The upper areolation varies somewhat in the type, but in the older leaves in well developed plants the cell-walls become thickened and the cells have a characteristic vermicular form.

The fruit is described by Dr. Burchard (Hedwigia, 1900, p. 152), but the authority seems insufficient. Fruit has however been gathered in the Pyrenees; cf. Rev. Bry. 1904, p. 123.

Even in the absence of obvious hair-points, the distinct auricles taken in conjunction with the narrow vermicular upper cells and the dark colour will readily distinguish it as a rule.

8. Campylopus introflexus Brid. (*Dicranum introflexum* Hedw.; *C. polytrichoides* De Not., Schp. Syn.) (Tab. XIII. A.).

Shorter, ½-2 *inches high*, dense, rigid, dark olive or golden green above, *reddish brown below.* Leaves crowded, rigid, straight, imbricated when dry, shorter, from an *oblong less concave base* shortly lanceolate-subulate with the margin incurved, tubular above, entire; nerve very broad, ⅔ *width of base*, excurrent

in a conspicuous hyaline denticulate arista, *deeply grooved at back above*, with alternate furrows and ridges, which may almost be termed lamellae ; angular cells hyaline or reddish, rather wider than the rest of the basal cells, forming *indistinct, hardly inflated auricles*, which, however, are usually conspicuous in the older leaves from their reddish brown colouration ; basal cells small, rectangular, hyaline, passing obliquely upwards and outwards in a triangular marginal band ; *very abruptly passing* into *small, obliquely rhomboidal chlorophyllose cells*, almost uniform throughout the rest of the leaf. Capsules aggregated, hardly furrowed, rugulose at base. Male plant, simple, slender, the leaves small and distant below, gradually enlarging to a coma at apex.

HAB. Heaths and rocky ground ; rare. Fruit very rare, not found in Britain.

C. introflexus is easily known from all the other species except *C. brevipilus* by the characters italicised above ; indeed, the colour and the hair-points alone serve to distinguish it at first sight ; the sudden transition from the hyaline to the chlorophyllose cells in an obliquely ascending line is very noticeable ; this is, however, more or less shared by the next species, which in other respects also is somewhat difficult at first to separate. The hair-points in the present plant are usually longer and more conspicuous—in the dry state by the imbrication of the leaves they are collected into a very distinct penicillate tuft at the top of the stem—the margin is not recurved in the upper part, the cells are shorter and hardly sinuose, and the deeply furrowed nerve is distinctive. In winter, when the young leaves are hardly mature, the hair-points are sometimes very inconspicuous, but they are later on developed.

The leaves are broader, shorter, and more rigid than in most of the species, and the aspect of the plant when dry, and especially the male plant, is not unlike that of *Polytrichum piliferum*.

C. introflexus is a southern species, which does not reach much further north than the south-western parts of England and Ireland. It has been found, however, in Wales.

Another southern species, *C. adustus* De Not., resembles dwarf plants of *C. atrovirens*, but has a narrower nerve, ⅓ width of leaf-base, and shorter cells. According to Limpricht, however, it lacks the stereid cells in the nerve, and must be placed near *C. subulatus*. Specimens gathered in the Channel Isles have been referred to this species, but they are by Braithwaite considered to be a form of *C. atrovirens*.

9. Campylopus brevipilus B. & S. (*C. fulvo-viridis* Stirt. in Ann. Scot. Nat. Hist. xi, 105 ; *C. pelidnus* Stirt. in Scot. Nat., No. xi, 233) (Tab. XIII. B.).

A very variable plant in size and colour, 1–3 inches high, usually pale, but at times dark green above and black below ; resembling *C. flexuosus* var. *uliginosus*, but with less flexuose leaves when dry ; stems easily separable, slender, leaves usually rather loosely set, sometimes interruptedly tufted. Leaves subulate from a lanceolate base, rather narrow, margin involute, towards the summit *very narrowly recurved*, faintly denticulate

above, at apex with a toothed point which is usually *slightly elongate and hyaline;* nerve rather *narrow*, ⅓ *width of base* or less, in section of 3–5 rows of cells, *the larger series* ("guide-cells") *occupying the middle of the nerve*, with stereid cells above, not large empty cells as in all the other species; *not grooved* at back, very slightly denticulate at back above. Angular cells very variable, hardly distinct, or forming distinct auricles; cells pale, the basal rectangular, in older leaves sometimes becoming elliptical, with the walls thickened and slightly porose, passing into the chlorophyllose as in the last, but less abruptly; upper cells longer than in that species, *narrowly linear-rhomboid or elliptical with a sigmoid curve;* the marginal very narrow. Perichaetial bracts with the margin recurved. Seta cygneous, rather short and thick.

Var. β. *auriculatus* Ferg. (*C. aurescens* Stirt. in Ann. Scot. Nat. Hist. viii, 104). Auricles enlarged, very distinct.

Hab. Moist heaths and bogs. Not frequent. The var. β less common.

A very variable species in size and habit, and also in the development of the auricles and of the hair-point; the latter is often altogether wanting, and every form of transition may be found between the var. *auriculatus* and the forms with the auricles scarcely traceable. The areolation is, however, distinctive, and, taken with the narrow nerve and the frequent presence of the short hair-point, will afford a pretty certain means of determining the plant; the recurved margin in the upper part is also characteristic, but is sometimes very slight and inconspicuous. Occasionally, in drier spots, the hair-points become elongated and the plant then simulates *C. introflexus*.

The fruit has only once been found, in 1895, by Jörgensen, in West Norway.

C. (*Trachypogon*) *aurescens* Stirt. appears to me, from authentic specimens, to be a robust, golden yellow form of this species, with the lower basal cells next the nerve frequently incrassate and porose. It is practically identical with the var. *auriculatus*.

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25. DICRANODONTIUM B. & S.

Stems slender, tomentose; leaves *setaceous*, with a *broad nerve*. Capsule *symmetrical*, on a *flexuose curved seta; calyptra entire at base; peristome teeth cleft to base* into two sub-equal, *subulate* divisions, remotely articulate.

Somewhat intermediate between Campylopus and Dicranum, with the habit and entire calyptra of the latter genus, but with the deciduous leaves, the capsule and broad nerve of the former; differing from both in the peristome.

Deriv.- δικρανο-(dicrano) two-pronged, and ὀδοντ-(odont) tooth. Referring to the forked peristome teeth.

Dicranodontium longirostre B. & S. (*Didymodon longirostrum* Starke ; *Didymodon denudatus* Lindb., Braithw. Br. M. Fl. ; *Dicranum notabile* Stirt. in Scot. Nat., No. xii, p. 257). (Tab. XIII. C.).

In soft, *silky* pale green tufts, with slender, flexuose, radiculose stems ; leaves *easily deciduous, flexuose-spreading or falcato-secund*, from a semi-sheathing *convolute* base gradually narrowed to a flexuose, very finely setaceous point, tubular above ; margin involute, sub-entire or finely denticulate towards apex ; nerve $\frac{1}{3}$–$\frac{1}{2}$ width of base, excurrent at apex in a rough point, thick, prominent at back, *in section of several rows of minute incrassate cells with a single median row of larger hyaline ones*. Auricles large, inflated, distinctly wider than the leaf base, hyaline or reddish brown ; basal cells rectangular, upper narrowly elliptic, or rectangular rhomboid. Seta *cygneous*, capsule small, cylindric ; lid straight, subulate, as long as capsule. Peristome pale red. Dioicous.

Var. *β. alpinum* Milde (*Campylopus alpinus* B. & S.). Taller, *more robust ; leaves closer, not deciduous, firmer*, usually more erect.

HAB. Banks and rotten wood in mountainous districts ; not common. The var. *β* in grassy places on mountains, rare. Fruit extremely rare, autumn and winter.

Somewhat resembling *Ditrichum flexicaule*, but with more divergent, flexuose leaves, which differ entirely under the microscope in the large auricles ; the Ditrichum, too, is almost confined to calcareous rocks and ground.

D. longirostre, and especially its var. *β*, resemble certain species of Dicranum ; but the form of the leaf-base with wide auricles and its areolation will separate it with ease from most of them ; *D. asperulum* also has a rougher subula and more serrate leaves and *D. longifolium* has a very different nerve section.

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26. DICRANUM Hedw.

Plants varying in size, often tall and robust ; leaves often falcato-secund, smooth or papillose, *lanceolate or lanceolate-subulate*, elongated ; nerve usually narrower, sometimes dilated ; areolation rectangular at base, with distinct angular cells. *Seta erect*, very rarely curved ; capsule erect or inclined, rarely strumose, often unequal, curved ; lid rostrate. Calyptra *entire* at the base (very rarely slightly fringed). Peristome teeth red, *confluent at base, broad, cleft about half-way* into 2 or 3 unequal divisions, minutely vertically striate below, transversely barred within. (Tab. XIV. C. 6.).

After a little practice the student will not have much difficulty in recognising a species of this genus, but it is difficult to define the characters which give it its distinctive habit ; the leaves are usually falcato-secund and subulate, and the capsule has an

appearance rather distinctive ; the larger species could hardly be taken for anything else unless for a Campylopus, and that genus usually has the leaves more erect and straight. However, there are a few species which it would be hard to distinguish as belonging to this genus upon first acquaintance, without microscopical examination.

DERIV.—δικρανον (dicrānoń) a two-pronged fork, from the form of the peristome teeth. Some of the earlier bryologists (followed in the first edition of this work) accent the first syllable, but the ā is long in the Greek compound, and there is, therefore, no reason why the more usual and more natural pronunciation should not be given.

The species fall somewhat naturally into the following Sections :—

A. ARCTOA. Plants autoicous, stems hardly radiculose ; leaves lanceolate-subulate, mostly entire or nearly so. Nerve in section of homogeneous cells, without guide-cells. Capsule very small and very little exserted, or distinctly strumose when dry on a longer seta. Plants usually small.

B. EU-DICRANUM. Plants robust, the leaves usually broad, mostly serrate ; lower cell-walls, and often the upper, interrupted by pores. Nerve in section of differently formed cells, with median guide-cells. Capsule on a long seta, cernuous, more or less curved, rather large.

C. APORODICTYON. Plants dioicous ; stems radiculose ; leaves subulate, entire or serrate, lower cell-walls (alone) rarely porose. Nerve in section (except *D. longifolium*) as in B. Capsule rather small, usually erect and symmetric, longly exserted.

1 { Leaves transversely undulate....2
  { Leaves not transversely undulate....5

2 { Upper cells long and narrow, communicating by pores....3
  { Upper cells short, quadrate or irregular, not porose....4

3 { Plant firm ; ls. recurved at margin below, with long spinulose teeth at margin and back of nerve above....*6. undulatum*
  { Plant weak ; ls. with saw-like teeth, nerve almost smooth at back....*9. Bonjeani*

4 { Leaves tapering, not papillose....*8. Bergeri*
  { Leaves more suddenly acuminate, papillose above....*7. spurium*

5 { Upper cells long and narrow, porose ; plant robust....6
  { Upper cells without pores....7

6 { Seta solitary ; leaves spreading or secund....*10. scoparium*
  { Setae aggregate ; ls. more uniformly falcato-secund....*11. majus*

7 { Nerve ½ or more of base, forming a long, fine subula....*20. longifolium*
  { Nerve not ½ of base....8

8 { Ls. suddenly narrowed above the wide base to long, fine, toothed points...9
  { Ls. gradually tapering....10

9 { Leaves with basal wing serrulate....*19. asperulum*
  { Basal wing entire, leaves falcate-secund....*18. uncinatum*

10 { Ls. distinctly serrulate above, papillose at back of apex.....11
Ls. entire, or serrulate at apex only, smooth or nearly so.....12

11 { Plant small, ls. strongly curled when dry ; capsule erect.....*17. montanum*
Plant larger ; ls. scarcely curled ; capsule cernuous.....*12. fuscescens*

12 { Plant slender, densely matted with tomentum ; lower cells of leaves porose .....*14. elongatum*
Plant less compact ; basal cells not porose (except *molle* and *fuscescens*)...13

13 { Plant small ; leaves nearly all broken across.....*15. strictum*
Leaves not fragile.....14

14 { Ls. strongly curled when dry, with distinct teeth at apex.....*16. flagellare*
Ls. not or slightly curled, entire or finely serrulate.....15

15 { Upper cells of ls. all quadrate ; stem radiculose.....16
Upper cells (or some of them) elongate ; stem rooting at base only.....17

16 { Basal cells rather short, not porose.....*13. Scottianum*
Basal cells longer, porose.....*12. fuscescens*

17 { Capsule suberect, furrowed, neck tapering ; seta short.....*1. fulvellum*
Capsule cernuous, neck strumulose when ripe ; seta longer.....18

18 { Tall ; ls. silky, basal cells porose ; capsule oblong.....*5. molle*
Plant ½-2 inches high ; basal cells not porose.....19

19 { Ls. flexuose-patent ; male flower far below perichaetium.....*3. schisti*
Ls. falcato-secund ; male flower close below perichaetium.....20

20 { Ls. with few angular cells ; capsule short, obovate.....*2. falcatum*
Angular cells distinct, coloured ; capsule oblong-cylindric.....*4. Starkei*

A. ARCTOA.

1. Dicranum fulvellum Smith. (*Bryum fulvellum* Dicks.) (Tab. XIII. D.).

Very densely tufted, dark or yellowish green, brown or blackish below ; 1–2 inches high. Leaves secund, falcate above, *flexuose when dry ;* from an oval base quickly narrowed to a subulate limb, very narrow at apex and entire or minutely denticulate ; angular cells large, *few,* brownish, not inflated ; the basal narrow, linear, upper also linear but shorter, the marginal row often of almost quadrate cells ; nerve very narrow at base, forming the greater part of the subula. Capsule *slightly exserted on a short seta,* reddish brown, *oval, with an equal neck,* or very slightly asymmetric, *wide-mouthed and almost turbinate after the fall of the lid, sulcate ;* lid obliquely rostellate ; peristome teeth large, wide-spreading when dry. Male flower just below the perichaetium, gemmiform.

HAB. Clefts of rocks on high mountains. Not common. Fr. summer.

Somewhat resembling *Blindia acuta,* but with less rigid, secund leaves, and less distinct, not enlarged nor orange auricles. The capsules are usually present in great numbers, and readily distinguish it from others of the genus by their small size, their form, erect and equal, and their striation and wide-

spreading peristome. There is some variation in the form of the *ripe* and empty capsule, which may be found in the same tuft rounded-oval with an abrupt neck and only slightly striate, or narrower, turbinate with a tapering neck, wide- mouthed, and more deeply sulcate. Owing to erroneous description of the capsule in *D. fulvellum* as smooth, our plants have not unfrequently been supposed to belong to *D. hyperboreum* C.M., which has a deeply furrowed capsule. This latter species is, however, a distinctly stouter plant, larger in all its parts, and when once known scarcely to be confused with *D. fulvellum*. It appears to be a rare species, confined to quite high latitudes. *D. Anderssoni* Schp., a closely allied species markedly differing in its immersed capsules, has been found in the Faeroes, and should be looked for on the northern coasts and islands of Scotland.

This and two following species are among the smallest of the genus; the latter differ not only in the fruit, but in having longer, more gradually narrowed leaf-bases. The marginal cells of the base in all this group above the coloured angular cells are wider than the median.

2. Dicranum falcatum Hedw. (*D. mediellum* Stirt. in Ann. Scot. Nat. Hist. xii, 113) (Tab. XIII. E.).

In wider, often taller patches than the last, which it resembles in size and colour. Leaves *regularly falcato-secund*, especially at the summit of the stem, *glossy*, *hardly altered when dry*, from a lanceolate base gradually subulate, concave, margin entire or slightly denticulate at apex; angular cells *few*, brownish, *not very distinct*, the other basal cells linear, the upper shortly rectangular, small, smooth. Capsule *on a longer seta*, small, subgibbous, *oval*, dark brown or reddish, *smooth*, when dry and empty contracted below the wide mouth, and sometimes irregularly furrowed or wrinkled, with a more or less evident struma. Cells of exothecium small, short, with *rather thick*, dark walls. Annulus persistent. Peristome bright red. Male flower *close below the perichaetium*.

Hab. Rocks and stony ground on the higher mountains; not common. Fr. summer.

Readily known by its beautifully and regularly falcate or circinate leaves; the oblique and unequal, smooth, strumose capsule separates it from the last; the shorter capsule, the closer, firmer, falcate leaves, and the indistinct angular cells from the next two species, than which it has a much neater, more compact habit.

D. mediellum Stirt. is a striking form, with short upper cells with decidedly protuberant walls, so that the subula is markedly papillose; similar forms however occur in both *D. Starkei* and *D. christi*, but as intermediate forms occur connecting them with the respective types, they cannot well be defined as varieties.

3. Dicranum schisti Lindb. (*Bryum schisti* Gunn.; *Dicranum Blyttii* B. & S., Schp. Syn., et plur. auct.) (Tab. XIII. F.).

Near *D. Starkei* but differing in its darker, lurid colour, stems more slender, branched, fragile; the leaves *flexuose-patent*, *hardly secund*, less rigid, *somewhat crisped when dry*, entire or

almost so, smaller ; upper cells slightly protuberant so that the subula is *more or less papillose ;* capsule shorter, with a tapering neck, only indistinctly strumose, *smooth* or faintly and irregularly furrowed when dry and empty, *pale brown* with a red mouth. Cells of exothecium with thin, pale walls. *Male flower far below the perichaetium*, usually near the base of the branch, axillary or occasionally terminal on a short branchlet.

HAB. Clefts of mountain rocks, rare. Fr. summer.

Very near *D. Starkei*, but differing in habit, colour, direction of leaves, which are papillose above, in the smooth capsule, and especially in the position of the male flower. I have not unfrequently found the male flower terminal on a short branchlet, which afterwards innovates below the flower, so that the latter ultimately appears to be axillary though not strictly so.

A peculiar form was gathered on Meall na Saone, by Mr. D. A. Jones, having male flowers on distinct plants, and therefore being functionally at least dioicous. It is possible however that the male stem might innovate below the flower as in the plants described above, and subsequently produce fertile flowers.

4. Dicranum Starkei W. & M. (Tab. XIII. G.).

Resembling *D. falcatum*, but taller, 1–3½ inches high, with looser stems and more distant *less firm and less strongly and regularly falcate* leaves, flexuose when dry ; of a brighter, not brownish green. Leaves longer, from a broader lanceolate base ; entire or frequently denticulate for some distance below the apex ; areolation rather wider and larger, angular cells *distinct*, brown, *forming clearly-marked auricles ;* nerve very narrow, excurrent. Seta *considerably longer ;* capsule of a duller and paler brown, *long*, *cylindric*, inclined, curved, *striate when dry*, strumose ; lid longly subulate, oblique, peristome paler. Cells of exothecium *thin-walled*, long and narrow. Annulus broad, separating. *Male flower close below the perichaetium.*

HAB. On mountains, in similar localities to *D. falcatum*. Fr. summer.

Distinguished from *D. falcatum* by the distinct auricles, and longer, paler, striate capsules ; from *D. schisti* by the characters detailed under that plant. It is usually a larger plant than either, with looser, longer leaves, secund but not so regularly falcate as in the former, more so and less crisped when dry than in the latter. It varies, however, considerably, giving rise to some troublesome forms. On the one hand in its smaller and less developed states it bears great resemblance to *D. schisti*, especially in the capsule, and I have seen plants that could scarcely be determined except by the position of the male flower. Even in otherwise well developed plants the capsule is sometimes small, scarcely strumose, and smooth or very indistinctly and irregularly furrowed. The angular cells also, though as a rule affording a good character of distinction between this and *D. falcatum*, are occasionally poorly marked. On the other hand *D. Starkei* in its taller and more robust forms comes very near to *D. molle*, and is occasionally very hard to separate from it ; the lower cells next the nerve have the walls at times slightly porose,

while the excurrent nerve cannot be looked upon as a distinctive character, since it is sometimes equally excurrent in undoubted *D. molle*. As a rule, however, the habit is more slender, the leaves more distant and more flexuose, the leaf-base narrower, and the cell-walls if porose much less conspicuously so.

B. EU-DICRANUM.

5. Dicranum molle Wils. (*D. arcticum* Schp. Syn.; *D. hypselum* Stirt. in Scot. Nat., No. xii, p. 258). (Tab. XIII. H.).

Taller than *D. Starkei*, with which it has considerable affinity; 2–5 inches high, yellowish or olive green above, dark brown or rarely whitish below, in *large, soft tufts;* leaves long, straight and erecto-patent, or slightly secund, rarely falcate; from a *broadly lanceolate base longly subulate with the margins incurved*, entire, acute at apex; nerve very narrow, usually hardly excurrent; angular cells distinct, large, orange brown, forming distinct auricles; the other basal cells long, narrow-linear, *with the cell-walls interrupted by pores*, upper cells linear or narrowly and sinuosely elliptical. Capsule oblong-cylindric, incurved, cernuous, slightly strumose, smooth or faintly striate; peristome dark red. Male flower close to the perichaetium.

HAB. On the highest Scotch mountains; very rare. Fr. summer.

I have removed *D. molle*, following Hagen, to *Eu-Dicranum*; the structure of the nerve, together with the porose cells, being perhaps of more importance than the form of leaf, the sub strumose capsule, the autoicous inflorescence, and the non-radiculose stems, and its general likeness to *D. Starkei*. Its robust habit also is almost that of *D. fuscescens* or small forms of *D. Bonjeani*. Wilson (*Bry. Brit.*) treats it as a variety of *D. Starkei*, to which it bears much resemblance in its smaller forms with secund leaves; but the leaves are distinctly larger, broader as well as longer, the areolation is different, and the lamina of the subula is continuous to the apex and broader. The fruiting characters are almost exactly the same, except that the capsule is slightly larger. The stems are soft and flexible, whence the name given to it by Wilson. The leaves are hardly twisted or altered when drying, by which it may usually be distinguished in the field from *D. fuscescens*, but some forms of that species, especially the var. *congestum*, are hardly separable from it without the microscope, though perfectly distinct when so viewed; and the same may be said of *D. scoparium* var. *spadiceum*.

6. Dicranum undulatum Ehrh. (Tab. XIII. I.).

Stems robust, tall, 3–10 in. high, decumbent at base, in loose, wide tufts, densely coated with tomentum, bright shining yellowish green. Leaves *very long*, spreading or squarrose, slightly turned to one side at times, the upper erect or faintly secund, forming a cuspidate tuft, not much altered when dry, from a long broadly lanceolate base gradually narrowed to an elongate, flexuose, but

not very narrow, sharp acumen, *margin recurved below* for about ⅓–½ the length of the leaf, thence upward *strongly spinosely serrate to apex ;* nerve narrow, vanishing in the apex, with two serrated ridges at back above ; cells at angles wide, orange brown, a patch of interior ones often hyaline, forming auricles which together cover about half the width of the leaf, the median cells between these and the nerve very narrow ; all the rest of the cells *almost uniform* throughout the leaf, linear-fusiform or narrowly and longly elliptical, the walls incrassate with rather few but very distinct pores, the marginal cells somewhat shorter. Perichaetial bracts long, broad, convolute, forming a cylindrical sheath ; setae *aggregated*, 2–5, rarely single, pale red, long ; capsule *rather small and short*, gibbous, curved, striate and pale brown when ripe and empty.

HAB. Woods and heaths. Very rare. Warwickshire (*Bagnall, 1887*) ; Perthshire (*Meldrum*) ; Forfarshire (*Miss C. Lyell*) ; Surrey (*E. F. Shepherd, H. W. Monington*) ; Gloucestershire (*H. P. Reader*). Fr. late summer.

D. undulatum is one of the finest of our species, and it is remarkable that its presence should have been so long undetected in this country, being as it is a widely-distributed plant on the Continent and in N. America. It recalls the most robust forms of *D. scoparium*, but its leaves are as long as or longer than those of *D. majus*, though straighter, and so strongly undulated and rugose as to give the dry plant a distinct silky sheen. The recurved margin at base and the very coarse serratures above are quite enough, by themselves, to separate the plant from all forms of *D. scoparium* and *D. majus*. The fruit has not been found in this country.

7. **Dicranum spurium** Hedw. (Tab. XIV. A.).

Green or yellowish green, robust, 2–3 inches high, less densely tufted than the next species, less tomentose. Leaves somewhat enlarged and tufted at the summit of the stem, when dry *incurved and cirrate-crisped* in the upper half, *strongly rugose, broadly oval*, wider above than at the line of insertion, quickly contracted to a *more acute acumen* (than in *D. Bergeri*), which is usually *twisted ;* margin more or less serrate above ; cells at base as in *D. Bergeri*, above also similar, but *rather smaller*, more crowded and more irregular, with somewhat sinuose walls, at back *scabrous with strong, rather distant, conical papillae ;* rough also at back of nerve. Seta pale, rather short ; capsule rather broader than in *D. Bergeri*, curved, irregularly sulcate when dry, with a short often strumulose neck.

HAB. Bogs and sandy heaths in woods, etc. ; rare. Fr. late summer.

Easily known from the next species by its leaves broader at the base and more quickly acuminated, twisted when dry, papillose at back ; from all the other species with undulate leaves by the small, irregular, papillose upper cells. It is a less distinct plant in its habit than *D. Bergeri* owing to the

more convolute leaves with narrower points, which bring it nearer to *D. Bonjeani*, but it is sufficiently marked to be quite recognisable in the field by its much broader, more flaccid, and more rugose leaves than the ordinary forms of that or any other species; certain states of *D. Bonjeani*, however, can hardly be separated except with the aid of the microscope. The nerve, on the other hand, in the present plant is more yellow and conspicuous at the back of the leaves than I have ever seen it in *D. Bonjeani*. The papillae vary somewhat in distinctness on different leaves.

8. Dicranum Bergeri Bland. (*D. Schraderi* W. & M., Schp. Syn.) (Tab. XIV. B.).

In large dense tufts, 2–6 inches high or more, dull green or more usually bright yellowish green, robust, tomentose with brown radicles. Leaves crowded, erect, and slightly spreading, hardly secund, when dry little changed, only very slightly flexuose, *strongly undulated and rugose*, especially when dry; slightly widening upwards from the insertion as in the last species and broadly ovate, rather quickly narrowing to an *oblong or broadly linear limb, somewhat obtuse at apex* or obtusely pointed; margin slightly denticulate towards apex, but variable, sometimes almost entire; nerve narrow, vanishing below the point, faintly denticulate or almost smooth at back, when dry conspicuous and *shining*: cells at angles orange-brown, quadrate, forming conspicuous auricles, narrow on each side of the nerve; above these a few cells are rectangular, the rest all narrow-linear, sinuose with the pores of the cell walls, incrassate, gradually shorter upwards, in upper part of leaf *small, short*, with incrassate walls, irregular (rounded, quadrate, triangular, etc.), *smooth at back*. Seta pale; capsule rather small, subcylindrical, curved, striate when dry. Autoicous.

HAB. Bogs on heaths. Very rare. Fr. autumn.

Very distinct in its broad, rather obtuse, strongly undulated leaves, with short, irregular areolation. From the last species it differs in its leaves less flexuose when dry, less convolute above, and smooth at the back. The seta is rather longer and the capsule a little narrower. It resembles in habit *Aulacomnium palustre* more closely than any species of its own genus, but the strongly undulate leaves will distinguish it in the field, and under the microscope the auricles, the elongated basal cells, and the non-papillose upper ones will readily determine it.

Not only are the leaves of *D. Bergeri* actually broader at the points than in the allied species, but this feature is the more conspicuous from the fact that they are less convolute or tubular, both when moist and in the dry state.

Both this and the last species have the nerve at back markedly yellow and shining in the upper leaves when dry.

D. Bergeri is sometimes found with short, dwarf, compact stems (var. *compactum* Ren. & Card.); and there is also, as in the last, some variation in the amount of denticulation of the leaf-margin. I have received forms from North America with short narrow leaves, and with the cells more or less elongated and large even to the apex; it can then scarcely be separated from *D. Bonjeani* but by the non-porose upper cells, which are shorter than in that plant.

9. Dicranum Bonjeani De Not. (*D. palustre* B. & S., Schp. Syn.; *D. interludens* Stirt. in Ann. Scot. Nat. Hist. xii, 114). (Tab. XIV. D.).

In its typical form the species grows in close tufts of a *pale fawn or light green* colour, more slender than *D. scoparium*, with the leaves erecto-patent or only very slightly secund, straight and appressed when dry, often in interrupted tufts, shorter (2-3 lines), and *less narrowly acuminate above, with a broad point, transversely undulate* when moist, more or less distinctly serrate on the borders, less concave, the nerve *smooth or faintly serrate* at the back, very narrow at base, the upper areolation irregularly hexagonal-elliptic. Seta solitary or sometimes in pairs, *paler*, rather more slender; capsule very similar, but shorter and usually lightly striate, rather paler. Male flower usually on a separate plant.

Var. β. *juniperifolium* Braithw. Leaves *broader*, rigid, *erect, straight*, brownish.

Var. γ. *calcareum* Braithw. Shorter, more rigid; leaves secund, *sub-falcate, concave, and sub-tubular above*, undulate only at apex. and *slightly serrate* only towards point.

Var. δ. *rugifolium* Bosw. Leaves spreading, *strongly rugose above and undulate throughout the greater part of their length*, sometimes contorted and twisted.

HAB. In marshes and on heaths in shady places. Common. Var. β less common; var. γ on chalk hills, rare; var. δ in bogs, rare. Fruit rare, late summer.

Besides the above varieties, *D. Bonjeani* presents many other less distinct or less widely spread and hence unnamed forms; it occurs with long, flexuous stems and distant, bright green, strongly falcate leaves, resembling slender states of the next species; sometimes it is very tall and robust, 4-6 inches high, with densely packed leaves; the latter vary greatly in length, form, and amount of serrature and undulation; a form occurs in bogs with long narrow strongly serrate leaves, the whole of the blade strongly undulated, remaining rugose when dry, and reminding us of *D. undulatum*.

In its ordinary forms it is not a difficult plant to distinguish. The short leaves with broad points, less serrate at back, the rather wider and more pellucid areolation, and the more or less strongly undulated leaves are characters one or more of which will always be found, and in practice the only plants with which there is likely to be any confusion are certain forms of the next species, which may be difficult, if indeed possible, to separate with certainty. The ordinary forms of that species are known by the leaves with longer, narrower, linear-subulate points and nerve 4-winged and serrated at back. The habit and the upper areolation separate the present species easily from *D. Bergeri*. It varies much in colour, being sometimes almost black, at other times of a beautiful glossy golden green.

The fruit is much more rare than that of *D. scoparium* with us, but in North America would appear to be not at all uncommon. The name *palustre* by which it is often known, but which should give place to the earlier name, is fairly appropriate, but the plant is by no means confined to marshy ground. I have found it growing abundantly on the thatched roof of a church in Suffolk!

I am doubtful whether var. *calcareum* is more than a somewhat starved form, owing its characters to the dryness of its station. The var. *rugifolium*

has been gathered in numerous localities and certainly is striking enough to deserve rank, although, as with the last named, its permanency as a variety may be open to question.

10. Dicranum scoparium Hedw. (*Bryum scoparium* L.) (Tab. XIV. C.).

A very variable species, in its typical form somewhat resembling *D. majus*, but smaller, *more densely tufted*, the leaves *shorter* (2½-4 lines), more crowded, often in interrupted tufts, less regularly falcate, sometimes erecto-patent, but almost always more or less turned to one side, glossy yellowish green, narrower at base, less concave, *not, or very rarely, undulate*, slightly flexuose at the point when dry, the subula broader and shorter (but longer and finer than in *D. Bonjeani*), the nerve slightly narrower at base, with three or four ridges at back above, which, with the margins, are *usually serrate*; lowest basal cells rather laxer, rectangular, with thinner walls, the upper rather wider, the marginal cells in the upper part usually pellucid, forming close but less acute serratures; cell-walls all porose, the contents more distinctly chlorophyllose, often, in the younger, active leaves, mixed with oil globules. Seta *solitary, reddish*, rather stouter; capsule cernuous, arcuate-cylindric, rufescent, not striate, with a distinct but not strumose neck; lid with a stouter beak.

Var. β. *paludosum* Schp. *Tall*, bright green, usually very white with tomentum; leaves secund, hardly falcate, *sharply toothed, transversely undulate* near apex. In boggy places.

Var. γ. *orthophyllum* Brid. In dense tufts; leaves *erect, spreading equally or slightly secund*, subula narrow, distinctly toothed.

Var. δ. *spadiceum* Boul. (vars. *alpestre* and *turfosum*, Braithw. Br. M. Fl.). In dense tufts; leaves *erecto-patent*, more or less appressed and rigid when dry; varying in length and acumination, *entire* and *smooth at back above*, or faintly denticulate, channelled or tubular in the upper part.

HAB. Woods, heaths, etc. Common. The var. β in bogs, not common. Var. γ on heaths, frequent. Var δ on moorland heaths and rocks and in mountain woods, not common. Fr. late summer.

The various forms of this common species defy description, and I have selected those alone which have the most salient points; but the student will find many intermediate forms, the naming of which would be found difficult, and will probably be far better not attempted.

Under the head of var. *spadiceum* Boulay has united the various forms with erect, almost or quite entire leaves, the most distinct of which are described by Braithwaite under the heads of var. *alpestre* Huebn. and var. *turfosum* Milde; these although differing in habit are much alike in form and structure of leaf, and together constitute a well-marked variety, which has been by

many authors ranked as a separate species (*D. spadiceum* Zett.). It connects the present species with *D. fuscescens* through the smooth-leaved vars. of that plant; I have indeed seen specimens which it is very hard to separate from forms of *D. fuscescens* var. *congestum* except by the rather more elongated cells with the upper cell-walls somewhat porose. It comes also extremely near *D. molle*, and some forms can hardly be distinguished from that plant except by the porose upper cell-walls and rather wider upper areolation.

On the other hand, through the var. *paludosum* and other forms, *D. scoparium* is closely linked with *D. Bonjeani*; indeed Roell, in an interesting discussion on the forms of these two species (*Hedwigia*, 1893, pp. 198, sqq.) states that in N. America so many intermediate forms are found that it is quite impossible to refer certain barren plants without doubt to either species, and all that can be done is to refer the forms with more narrowly acuminate, often falcate leaves and rather longer upper areolation, to *D. scoparium*, and those with the contrary characters to *D. Bonjeani*. The forms of *D. scoparium* with undulated leaves are rare, and may usually be recognised by their longer, finer, more channelled points more strongly toothed at the back. When in fruit it may be recognised by its firmer, red seta, and reddish brown capsules, but even these characters are occasionally found in *D. Bonjeani*. On the whole I think the student must be prepared to find that some forms cannot be labelled with a great degree of certainty.

11. **Dicranum majus** Turn. (Tab. XIV. F.).

Very tall and *robust*, 2–5 inches high, the stems tomentose, only *loosely cohcrent* above, glossy yellowish or deep green, slender, prostrate below and ascending. Leaves *very long* (3–5 lines), not crowded, *always regularly falcato-secund*, hardly altered when dry, from a broad half-amplexicaul concave base gradually narrowed to a long channelled subula, *not transversely undulate*, the lamina distinct to the apex; nerve narrow, vanishing in the point, *with several rows of teeth in the upper part at back*; margin strongly toothed above; angular cells lax, quadrate, brown, next the nerve thinner and paler; above linear-rectangular, 5–8 times as long as broad, *very similar to apex, but shorter and smaller in the upper part; all with the walls very porose*, giving a sinuose outline to the cell; rather obscure, smooth at back. Setae *2 or more*, sometimes as many as 5, *from the same perichaetium*, rarely single, *slender*, flexuose, *pale yellow*; capsule rather small, arcuate, oblong, greenish brown, faintly striate, finally blackish; lid with a very long and slender beak. Male flower gemmiform, among the tomentum of the stem.

HAB. Woods in mountain districts, not unfrequent. Fr. late summer.

One of the finest species of the genus, almost always readily known by its tall lax stems with regularly falcate leaves, larger and longer than in *D. scoparium*, the only plant with which it is likely to be confused. When in fruit the aggregate capsules on pale slender setae are unmistakable; tall barren forms of *D. scoparium* may occasionally resemble it, but the leaves of that plant are always shorter, and usually less regularly falcate, the areolation rather wider and more pellucid, more distinctly chlorophyllose, looser at base, and the tufts denser. I have however seen forms of *D. majus* which it is extremely difficult, in the absence of fruit, to separate from *D. scoparium*.

D. majus, unlike its near allies, is not a very variable species.

12. Dicranum fuscescens Turn. (*D. Fergussoni* Stirt. in Ann. Scot. Nat. Hist. viii, 42). (Tab. XIV. E.).

Usually robust, 1–4 inches high, dull or yellowish green, tomentose. Leaves rather closely set, more or less secund or sometimes strongly falcato-secund, *when dry distinctly crisped*, especially the upper ones, from an oblong-lanceolate base gradually narrowed to a long flexuose channelled subula; nerve somewhat variable in breadth, $\frac{1}{6}$–$\frac{1}{5}$ width of leaf at base or sometimes wider, closely denticulate at back above, often excurrent in a more or less strongly toothed point; margin usually *strongly denticulate above*, but *sometimes entire* or nearly so, occasionally slightly recurved; cells at angles lax, quadrate, brown, narrower towards the nerve, forming distinct coloured auricles; other basal cells elongate, linear, 3–8 times as long as broad, with the cell-walls with or without pores; in the upper part of the leaf base becoming shorter and *more or less quadrate, or irregular, angular*, at apex often rather larger and elliptical-rhomboid; upper cells usually very strongly *papillose* at back, but variable in this respect, and sometimes quite smooth. Capsule on a long rather stout seta, *inclined*, gibbous, *arcuate*, greenish brown till ripe, finally reddish brown, striate, when dry and empty sulcate, constricted below the mouth in front; lid longly subulate, oblique.

Var. *β. falcifolium* Braithw. Densely tufted, deep green; *leaves all falcato-secund*, shorter and less attenuated above.

Var. *γ. congestum* Husnot (*D. congestum* Brid., Braithw. Br. M. Fl.). Leaves *broader*, the nerve narrower, the subula less elongate, *less serrate at margins and back*, smooth or only faintly papillose. Upper cells *larger*, longer, *sinuosely elliptic-rhomboid (not short, quadrate and angular)*.

Hab. Among grass and upon rocks, on mountains, frequent. The var. *β* not common; the var. *γ* on high mountains, rare. Fr. autumn.

A very difficult and variable species; the leaves may be smooth or highly papillose, entire at margin or closely denticulate, narrow or broad at the base; the fruit varies in colour, in the amount of striation, in direction, and in form from broadly ovate to narrowly cylindric. The form that must be looked upon as typical has very narrow elongated flexuose leaves, from a narrow base, with rather broad, thick nerve, about $\frac{1}{4}$ width of base, highly denticulate at back and margins above, with the cells spinosely papillose; areolation rarely porose, quickly becoming shortly rectangular and almost quadrate at the upper part of the leaf-base, rather regularly arranged, and more or less uniform from thence to the apex, or somewhat elongated above; in the var. *congestum* the leaves are less elongated and flexuose, the nerve narrower and leaf-base wider, and the cells, instead of quickly becoming short and sub-quadrate in the upper part of the leaf-base, become gradually shorter, elliptical, and sinuose, and it is only quite high up in the subula that they become short, irregularly rhomboid or elliptic, at the apex sometimes much elongated and larger; in no part does it show the minute more or less regularly sub-quadrate, papillose cells of *D. fuscescens*. I have not, however, found the characters other than that of the areolation ascribed to *D. congestum* by

Braithwaite either constant in or peculiar to the *congestum* form, and I do not think it can properly be accorded a higher rank than a variety. I gathered it, for instance, very distinct in areolation and form of leaf-base, on the summit of Ben Lawers in 1893, but with longer leaves much more narrowed above, than in the plant described and figured by Braithwaite. I have also found plants with some leaves having the areolation of typical var. *congestum*, while leaves on the same stem have quite different cells, closely approaching those of the type. Nor can the presence or absence of pores be looked upon as a good specific character, for specimens may be found showing all the features of typical *D. fuscescens*, but with the lower cell walls distinctly porose. As a rule, however, the areolation characteristic of the type is associated with thin-walled, non-porose basal cells.

I have dropped the vars. *flexicaule* Wils. and *robustum* B. & S., feeling convinced that they are better merged in the var. *congestum*, with which they agree entirely in the important character of the areolation and smooth leaf apex, differing only in secondary characters such as occur quite as markedly in allied species, as *D. Bonjeani*, etc., without being held there to constitute good varieties.

D. Muehlenbeckii B. & S., has been recorded from one or two localities, but I have not seen any specimens which I could refer to it. It is a continental plant, perhaps best regarded as a sub-species of *D. fuscescens*, from which it differs in the leaves more crisped when dry, highly tubular above and concave below, with the lower areolation laxer and thin-walled, the stems highly tomentose, etc.

D. fuscescens may be recognised from *D. scoparium* by the narrower leaves more crisped when dry, and the minute upper areolation. It much resembles *D. Scottianum*, in some of the forms of var. *congestum*, but the basal areolation is longer, with the cell walls perforated by pores, and the habit is different; the form of the capsule distinguishes the species further, but this is often absent, especially in *D. Scottianum*. The var. *congestum* also very closely resembles *D. molle*, both in habit and in leaf structure, but the latter plant has the nerve at the base of the leaf much narrower, and all the upper areolation distinctly longer and in proportion narrower.

I have gathered a curious form of *D. fuscescens* on a tree trunk near Penmaenmawr, N. Wales, with very short basal cells.

A very remarkable form was gathered by Mr. T. H. Russell near Loch Garten, Inverness, with the capsule almost or quite erect and symmetric, the lid suberect or inclined not decurved. The leaf structure approached very close to var. *congestum*.

C. APORODICTYON.

13. Dicranum Scottianum Turn. (*D. Scottii* Turn., Braithw. Br. M. Fl.; *D. subnitescens* Stirt. in Ann. Scot. Nat. Hist. viii, 44). (Tab. XV. B.).

Robust, in dense large rounded tufts, 1–3 inches high, dull or yellowish green, tomentose. Leaves crowded, larger than in the allied species of this Section, rather rigid, glossy, slightly twisted and appressed when dry, patent and subsecund when moist, from an oblong base gradually linear-lanceolate, *broader than in any of the following species in the upper half, quite entire* or with only a few very obscure denticulations at the apex; nerve $\frac{1}{5}$-$\frac{1}{4}$ width

of base, thick, shortly excurrent, smooth above, areolation at angles large, orange brown, forming distinct auricles ; above these, almost from the base, the cells are very small, narrow-linear or rhomboid, 2–4 times as long as broad, quickly becoming shorter, *elliptic-rhomboid ;* in the upper part as wide as long, rounded, quadrate, or irregular, *very small ;* all golden yellow or pellucid, with rather thick walls, smooth at back. Capsule sub-cylindric, *erect*, straight or slightly curved, sub-plicate when dry. Peristome teeth short, only slightly cleft at apex, fragile.

Hab. Rocks in subalpine regions, chiefly in the west ; not common. Fruit rather rare, late summer.

A fine species of western distribution, which seems more at home with us than in other countries. Larger than its allies, with stouter dense leaved stems ; closely resembling *D. fuscescens*, but with entire leaves, and with the basal areolation usually shorter, the cell-walls not porose, the upper cells not papillose ; the leaves are also shorter in the subula, more densely crowded and less flexuose when dry. It is very near *D. fulvum*, a continental species, which however has denticulate leaves and still shorter chlorophyllose cells.

The fruit when present is produced in abundance.

14. Dicranum elongatum Schleich. (Tab. XV. A.).

In large *compact* tufts, *densely tomentose*, pale yellowish green, 3–6 inches high. Stems straight, with the leaves *erect and appressed when dry*, the upper very little twisted ; erecto-patent or slightly secund when moist, straight, rather small and short ; from an oblong-lanceolate base linear-subulate, ending in a very narrow, acute, but not very elongate or flexuose point, channelled above, *entire or very faintly toothed* at apex ; nerve narrow and rather ill-defined below, excurrent ; angular cells large, orange, forming distinct auricles ; basal cells linear, incrassate, *with the cell-walls porose*, above shorter, elliptic, in the upper part of the leaf minute, *oval*. Capsule *small*, greenish brown, subcernuous, ovate and gibbous ; rarely shortly oval, erect and symmetrical (var. *orthocarpum* C.M.) ; peristome teeth irregular.

Hab. Mountains ; rocks and wet places, very rare. Scotch Alps. Shetlands. Cheviots. Fr. late summer.

Easily known by its yellowish green very dense tufts with straight, slender stems interwoven with reddish tomentum. In the leaf it is almost a miniature of *D. fuscescens*, but it is known from the ordinary form by the smaller almost entire leaves. Several allied species have been described on the Continent and in N. America. Of these *D. groenlandicum* Brid. has been recorded from Ben Lawers (Hedwigia, 1900, p, 149), but on quite insufficient evidence.

15. Dicranum strictum Schleich. (Tab. XV. C.).

Slender, in bright or yellowish green tufts, resembling *D. flagellare*, but with the stems fragile, the leaves erect or spreading, straight or slightly flexuose when dry, *not crisped, very fragile,*

with the apex usually broken off; from a narrow lanceolate base finely canaliculate-subulate, *entire or faintly denticulate* at margin above, nerve *narrow* at base, about $\frac{1}{7}$ of width of leaf, smooth at back above; cells at angles lax, brown or hyaline, forming moderately distinct auricles; usually, but not always, a few narrower cells intervene between these and the nerve; basal cells *elongate-rectangular, thin-walled*, 4 8 times as long as broad, gradually becoming shorter above, very shortly rectangular or almost quadrate near the summit, smooth at back. Capsule oblong-cylindric, rather small, smooth; lid subulate, straight.

HAB. Old rails and trunks of trees, rarely on walls; very rare, and sterile in Britain. Staffordshire; Yorkshire; Midlothian; Inverness.

Bloxam's Staffordshire plant was recorded as *D. viride*, and is described by Braithwaite and our other authors under that name. Mr. Bagnall however kindly sent me one of Bloxam's original specimens, together with specimens gathered by himself in one or two other localities in the same district (one from a mud-capped wall near Alton, Staffs.!), and an original type specimen of Sullivant's of *D. viride* (*Campylopus viridis* Lesq. and Sull.); and after carefully comparing these and other specimens of *D. strictum* and *D. viride*, I have no hesitation in saying that all our British specimens belong to *D. strictum*. In *D. viride* the areolation of the whole leaf, almost to the auricles, is very small, firm and short, the cells even close to the base being hardly twice as long as wide, and almost all are chloropyllose. On the other hand *D strictum* has a much longer areolation throughout at least the greater part of the leaf, all the cells of the leaf-base being elongated, and for a long distance upwards from the base free of chlorophyll. All our plants agree exactly with the latter, with perhaps a slightly less clear demarcation of the basal auricles. The basal cells are quite as long and narrow throughout the whole expanded part of the leaf, and show no approach to the short, chlorophyllose, firmer-walled cells of *D. viride*. Husnot gives a futher distinction, viz., that the wide auricular cells of *D. viride* extend to the nerve, while those of *D. strictum* do not occupy the whole width of the lamina, a few rows of narrower cells intervening between them and the nerve; I am inclined to doubt whether this distinction is a perfectly constant one: but so far as it goes it distinctly supports the view taken here, our British plants never showing the auricles extending markedly to the nerve as in *D. viride*. The leaves too, though slightly crisped when dry, are much less so than in that species, and even the amount of curling which is present is chiefly accounted for by the plants being for the most part young. Mr. Bagnall's later gathering, from Alton, in which the plants are older, show the typical straight, rigid leaves of *D. strictum*. This is also the case with the Edinburgh plant.

Bloxam's specimen is mixed with a little *Dicranoweisia cirrata*, and it seems just possible that a leaf or two of this may have been examined with the *Dicranum*, and have given rise to a supposition that the basal areolation was variable in character; at any rate the cells in that species have a marked resemblance to those of *D. viride*, although the basal angular cells are less distinct.

It may be noted that quite recently, indeed since the above was written, M. Camus has published a paper showing that the French plant hitherto recorded as *D. viride*, from Coetquen (Cotes-du-Nord), is really *D. strictum*, a species which he remarks has hitherto been considered absent from the lowlands of middle Europe.

D. fragilifolium Lindb., another very brittle-leaved plant, is nearer *D. fuscescens* and *D. elongatum*, with the lower cell-walls distinctly porose; it is found in Scandinavia and N. America.

The plate representing this species (Tab. XV.C.) shows the areolation (near the base) of *D. viride* as well as that of *D. strictum*, for purposes of comparison.

16. Dicranum flagellare Hedw. (Tab. XV. D.).

In close tufts, 1–2 inches high, bright or yellowish green, radiculose, frequently emitting numerous axillary, erect, *straight flagella* with minute leaves. Leaves curved, subsecund, *crisped when dry*, from an oblong base gradually narrowed to a linear-subulate tubular acumen, slightly denticulate at and near the apex; nerve narrow but variable, usually $\frac{1}{4}$–$\frac{1}{5}$ width of base, not excurrent, *slightly denticulate* at back near apex; angular cells wide, quadrate, yellowish brown, reaching to or almost to the nerve; above rather loosely rectangular, becoming shortly rectangular in the limb, towards the summit quadrate or nearly so, *irregular, angular, smooth at back*. Capsule elongate, cylindric, symmetrical or faintly curved, striate when dry; lid subulate, oblique.

Hab. Rotten tree trunks, very rare; Kerry; Kent; Staffordshire; Berks. Sterile in Britain.

On the Continent this is a not unfrequent species, and its rarity here is therefore somewhat remarkable. The flagelliform branchlets are not always present. It is then much like *D. montanum*, but that species forms neater rounded cushions usually (in this country at least) on *living* trees, and has the leaves papillose at back, more denticulate above and more closely and strongly crisped when dry. From *D. strictum* it differs in the hardly fragile, crisped, denticulate leaves, the latter character separating it from *D. Scottianum*, which also has much smaller, more rounded areolation, and with us at least grows in quite different situations.

17. Dicranum montanum Hedw. (Tab. XV. E.).

In small dense *rounded cushions*, bright or dark green, hardly 1 inch high. Leaves spreading or subsecund, *strongly crisped when dry*, rather shorter and smaller than in the last species, from a lanceolate base gradually narrow-linear, less acutely subulate, slightly tubular above, *distinctly denticulate towards apex at margin and on the back of the nerve*, which is narrow, about $\frac{1}{5}$ width of base, not excurrent; cells at angles *not much enlarged*, hyaline or brown, the other basal cells narrowly hexagonal-rectangular, thin-walled, above shorter, in the upper part subquadrate, *strongly papillose*. Capsule oblong-cylindric, erect or slightly curved, finally plicate.

Hab. Roots and trunks of trees in woods, etc.; rare. Sterile in Britain.

The distinctly papillose and strongly denticulate shorter leaves, much crisped when dry, abundantly distinguish this plant from the allied species. The margin is frequently minutely denticulate almost to the base by the projecting transverse walls of the cells. The apex is wider than inthe preceding

species or indeed than any of this section. The small deep green cushions with strongly crisped leaves are not unlike those of *Dicranoweisia cirrata*, but under a strong lens the denticulations of the subula are apparent.

A tall, lax form was gathered by Mr. J. B. Duncan in Shropshire.

18. Dicranum uncinatum C. M. (*Thysanomitrium uncinatum* Harv.; *Dicranodontium circinatum* Schp. Syn.; *Dicranum capnodes* Stirt. in Scot. Nat. No. xii, p. 257). (Tab. XV. F.).

Golden green, reddish brown below, in lax tufts, 2-6 inches high, robust. Leaves glossy, laxly placed, *regularly falcato-secund or circinate*, hardly altered when dry; the upper very long, from a short, broadly oblong sheathing base, hardly $\frac{1}{5}$ the length of the leaf, quickly contracted into a lanceolate-subulate channelled limb, which gradually narrows to a long setaceous point. Nerve $\frac{1}{5}$–$\frac{1}{4}$ width of base, very thin, in section of a median row of large empty cells, with numerous stereid cells before and behind, marginal cells on both faces rather small, turgid at back of leaf; finely denticulate at back above, excurrent in a spinulose arista; *margin at base entire*, near the summit finely denticulate. Angular cells wide, very thin and hyaline or pale brown, occupying all the base to the nerve, very distinctly marked in the older leaves from the rest of the cells; above these the cells are golden green, the median widely rectangular with dark walls, gradually narrowing upwards, *the outer in several rows of very narrow linear cells forming a broad marginal band* becoming wider as it passes upwards; about the shoulder of the leaf-base the cells become uniform, narrow-linear, obscure, continuing so to the summit, a single marginal row usually being rhomboid or elliptical with projecting oblique walls forming minute denticulations which become more distinct towards the apex. Seta short, arcuate or straight; capsule *erect*, *cylindric*, dark brown; peristome teeth cleft half way, the divisions subulate.

HAB. Mountain rocks in woods, etc.; rare. Fruit very rare, not found in Britain.

A very fine plant, usually very distinct, but when starved resembling some falcate-leaved forms of *Dicranodontium longirostre*. It differs from *D. longifolium* in the narrower nerve of very different structure, and in the less alpine station as well as in habit, the leaves being more setaceous, not whitish below, etc. *D. uncinatum* is very frequently associated with *D. asperulum* in the field, and some slender forms come very near that plant in habit, and indeed can scarcely be distinguished in the field, but *D. asperulum* is usually recognised by the less falcate, more flexuose leaves, and may always be known under the microscope by the margin sharply and closely denticulate from the base upwards.

The distinctive areolation of the leaf base is best seen in the older leaves, and their rich and varied colour makes them a beautiful object under the microscope.

The calyptra appears to be slightly fringed at base, in this respect showing an approach to Campylopus.

19. Dicranum asperulum Mitt. (*Dicranum aristatum* Schp. Syn.) (Tab. XV. G.).

In paler, more silky tufts than the last species, less robust and less glossy; stems very slender. Leaves usually readily deciduous, erecto-flexuose or falcate, from an oblong-lanceolate sheathing base, rather longer in proportion to the length of the leaf, narrowed to a fine channelled setaceous subula; margin *from the middle of the leaf-base upwards densely and strongly denticulate;* nerve about $\frac{1}{5}$ width of base, at back above with several serrate ridges, *excurrent into a densely spinulose arista;* angular cells lax, hyaline, reaching to the nerve; above rather laxly rectangular, chlorophyllose, narrower towards margin, decreasing in width upwards, in the upper part resembling those of the last species, but shorter and less obscure. Seta straight, capsule oval-cylindric, erect. Peristome teeth cleft half-way.

Hab. Sandstone rocks on mountains. Rare. Sterile in Britain.

A somewhat variable plant, and occasionally coming very near the last species; usually however the much closer denticulation of the margin, from very near the base of the leaf, and the very rough arista, together with the more slender habit and smaller, less regularly falcate leaves, will distinguish it. The auricles also are somewhat wider and more distinct. There is a tendency towards the same peculiarity in the basal areolation, but it is not nearly so marked. It resembles *Dicranodontium longirostre* even more closely, but the same characters will usually separate the two, and the auricles of the latter plant are more distinct and the nerve rather wider.

This and the preceding species resemble *Dicranodontium* in the habit and the leaves, and have been included in that genus; but the capsule and peristome are quite dicranoid.

20. Dicranum longifolium Ehrh. (Tab. XV. H.).

In compact, pale, bright green, soft, silky tufts, stems ascending, here and there geniculate. Leaves long, falcato-secund, hardly crisped when dry, from a lanceolate base *longly subulate-setaceous*, tubular above; *nerve very broad, $\frac{1}{3}$ or more width of base*, widening a little just above the line of insertion, occupying all the upper part of the leaf, remotely denticulate above at back, more closely at apex, in section of *three rows of nearly equal, empty, hyaline cells;* margin slightly denticulate above; angular cells lax, hyaline or brownish, reaching to nerve, above hexagonal-rectangular, decreasing in size upwards, to narrowly elliptical or linear. Capsule erect, straight or incurved, cylindric, smooth.

Hab. Mountains, rare; only recorded from three or four localities in Scotland. Sterile in Britain.

Distinct from all the other British species in the great width of the nerve, rendering the leaf-bases pale and shining, and therefore not likely to be taken for any other under the microscope; in habit it is much like forms of *D. fuscescens*, but can generally be recognised by the pale, whitish green, glossy leaves, which are more finely setaceous than in that species

D. albicans B. & S., a continental species, has a still wider nerve, occupying the greater part of the leaf-base; indeed leaving hardly any margin, and in this respect forming a transition to Leucobryum.

D. Sauteri B. & S. is described by Braithwaite as British, but its authority is doubtful, being confined to unnamed specimens found in a herbarium mixed with other mosses labelled as from Braemar. In addition to this uncertainty there is considerable doubt whether *D. Sauteri* is anything more than a variety of *D. longifolium*; the only important differences being the more sparing denticulation and the considerably narrower nerve, $\frac{1}{5}$ width of base; several observers have found, however, that the former character is not constant, and the Marchese Bottini states that he has found both plants growing together, with many intermediate forms as regards even the width of nerve. I have hardly felt justified, therefore, in retaining it as a species, whether or not it be actually a British plant.

Tribe 7. Leucobryeae.

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27. LEUCOBRYUM Hampe.

Mosses of a peculiar habit, growing in dense *white or glaucous tufts*, with close tumid foliation. Leaves *composed entirely of the nerve with the exception of a few rows on each side* (principally near the base) *of very thin hyaline cells*; nerve of two or more layers of large rectangular hyaline cells, *their internal walls perforated with large circular pores*, with a central layer of narrow chlorophyllose cells. Calyptra, capsule and peristome dicranoid.

The species of this genus are for the most part tropical, and bear some superficial resemblance to Sphagnum in their colour and their hygroscopic properties; they are, however, intimately allied to the Dicranaceae, and between them and species of Dicranum such as *D. longifolium* and *D. albicans*, or, as far as the leaves are concerned, *C. fragilis* in Campylopus, there is practically no difference in structure of any real importance except the pores in the cell-walls of the nerve.

Cardot has recently given us a masterly treatise on this genus (Recherches Anatomiques sur les Leucobryacées, Cherbourg, 1900).

DERIV.—λευκο-(leuco) white, and *bryum*, moss.

{ Tall; leaves 2-4 lines long; capsule arcuate, strumose.....1. *glaucum*
{ Short; leaves 1-2 lines long, thin; capsule almost erect, hardly strumose 1*. *albidum*

1. Leucobryum glaucum Schp. (Tab. XVI. B.).

In very dense soft tufts or patches, *2–8 inches high*; pale glaucous green above, whitish below. Stems dichotomously forked, *robust*, without radicles, very fragile. Leaves crowded, erecto-patent or slightly secund, appressed when dry, entire,

tubular from the incurved margins, oblong-lanceolate or lanceolate from an oval base, contracted at the insertion; formed almost entirely of the broad thick nerve, with 2–6 rows of very thin, hyaline, rectangular or linear cells on each side, forming a pale inconspicuous band widest below and vanishing at about half-way up the leaf or higher; the apex either acute or rather obtuse with a short apiculus. Dioicous; capsule variously exserted, on a dark brown seta, *inclined, more or less arcuate*, small, castaneous, oblong or cylindric, striate, when dry furrowed, *strumose*. Peristome deep red, dicranoid. Lid longly rostrate. Male plants in distinct tufts, more slender, flowers terminal.

Hab. Heaths and woods on turfy ground. Common. Fruit rare, all through the winter months, and persisting through the year; very abundant when produced.

The apical leaves often produce at their tips a tuft of radicles, whence are developed a cluster of minute plants, these subsequently falling off and giving rise to new colonies. Minute, lanceolate leaves are often found among the ordinary ones.

When dry the plants lose much of their colour, becoming almost white. The capsules are small for the size of the plant.

A curious state from Hedsor, Bucks., collected by Miss C. M. Gibbings, since found in other localities, forms spheroidal balls or cushions, entirely unattached, consisting of stems radiating outwards from a central point, and showing no lack of vigorous growth in spite of the freedom from anything like attachment, which obviously must have lasted for a considerable period. I have described elsewhere a similar curious state of things in *Porotrichum alopecurum*.

* **Leucobryum albidum** Lindb. (*Dicranum albidum* Brid.; *L. minus* Hampe, Braithw. Br. M. Fl., Vol. I., Suppl.) (Tab. XVI. A.).

Much smaller than the above species, in *dwarf*, very dense tufts. Leaves crowded, *shorter, narrower, more acute, less* spreading. Capsule slightly inclined, *almost symmetrical, scarcely strumose*.

Hab. New Forest (*Piffard*).

This plant has been variously ranked as a variety of *L. glaucum* and as a species, but I am convinced that it is hardly deserving of specific rank. The New Forest plant, of which I have a specimen, through the kindness of Dr. Braithwaite, is very distinct in its minute capsules, only slightly curved, and the general smallness of its parts; but even there the leaves are variable in width, and the neck of the capsule is distinctly unequal and prominent, almost amounting to a struma. Moreover, in specimens from the U.S.A., sent by Mrs. Britton, the plants, though slender and small-leaved, are taller, and the capsule is exactly that of *L. glaucum*. And further, I have gathered a plant in the New Forest which, while named *L. glaucum* by Dr. Braithwaite, much resembles the smaller form, and in the capsules, indeed, comes certainly nearer Piffard's plant than does the above-mentioned American one; in fact, it constitutes an intermediate link. On the whole, I do not think the

characters of *L. albidum* are sufficiently marked or constant to warrant its maintenance as an independent species. Cardot (Bull. de l'Herb. Boiss., 1904, p. 204) has expressed the opinion that it cannot be considered as more than a variety of *L. glaucum*.

There exists, however, still a certain divergence of opinion among American bryologists as to the relationships of the plants of the Northern and Southern States, as well as to their nomenclature; and the true position as well as the proper name of our plant must in some degree depend upon the final judgment upon the American species.

According to Lesquereux and James (*Manual of N. Amer. Mosses*) *L. albidum* differs from *L. glaucum* in its time of fruiting, which is said to be in summer, not in winter. In Piffard's New Forest plant, however, which was gathered in April, the capsules are ripe and appear to have just lost their lids, and there can hardly be any difference between the two. On the other hand, the fruiting plants of *L. glaucum*, which I gathered in the same neighbourhood, were just ripe in July; and evidently no reliance can be placed on this character.

Order VII. FISSIDENTACEAE.

Plants with truly *distichous, vertically placed* leaves, in one plane; in all the British species more or less oblong-lanceolate, and *equitant or clasping the stem*, the basal part of the upper side of the limb as it were split to the nerve into two laminae; the cells *hexagonal or rounded*. Fruit lateral or terminal, exserted, small, *peristome dicranoid*.

The plants of this Order belong with one or two exceptions to the large genus Fissidens,—Octodiceras being by many authors considered as a sub-genus—and, although very variable in size, possess a uniform habit by which they are readily known, and indeed form one of the most natural of the Orders of mosses.

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28. **FISSIDENS** Hedw.

The diagnosis given above includes the most important characters of the genus; to this it may be added that the fruit somewhat resembles that of Dicranella, but is always smooth, not striate; the peristome is usually very densely and highly papillose, the papillae often tending to take a spiral arrangement, instead of being in vertical lines, and the divisions are subulate, straighter and more rigid than is usual in Dicranum. There is a central-strand present in the stem in Fissidens, and stomata are present on the capsule.

The position of the male inflorescence is exceedingly variable, and in the descriptions as well as in the arrangement of the species I have paid little heed to this character.

The synonymy of the various species, especially of the more minute ones, is exceedingly involved and complicated; I have for the most part followed Braithwaite in his *original* nomenclature (*Brit. M. Fl.*, Vol. I., pp. 67–80), as being on the whole the most

rational. I have used almost the same terms as Braithwaite in designating the different parts of the leaf, indicating by "sheathing laminae" the conduplicate portion, by "superior lamina" the part of the leaf beyond the sheathing laminae on the upper side of the nerve, by "inferior lamina" the whole of the lamina on the lower side of the nerve. The nerve itself will in most of the species be found to reach just to the apex, where it often becomes confluent with the cells of the thickened border when that is present.

The calyptra is small and cucullate, but occasionally it may be mitriform and more rarely quite entire at the base; but these differences do not appear to mark any important divergence of types. The areolation of the lowest leaves on the stem is usually laxer than that of the upper ones.

E. S. Salmon has given a careful discussion of the morphology and origin of the leaf of Fissidens in a paper "On the Genus Fissidens" (Ann. of Bot., 1899).

DERIV.—Latin *fiss*-split, and *dens* a tooth. From the peristome teeth.

1 { Leaves with distinct cartiliginous border (seta terminal).....2
  { Leaves without cartiliginous border.....10

2 { Male inflorescence axillary; nerve usually percurrent, and forming a mucro.....3
  { Male inflorescence basal or terminal; nerve rarely reaching apex.....5

3 { Tufts matted with red radicles.....5*. *Curnowii*
  { Stem not radiculose.....4

4 { Plant small; leaf-border narrow; on banks, etc.....5. *bryoides*
  { Plant larger; ls. opaque, nerve and border thick; on wet rocks...6. *rivularis*

5 { Leaves very acutely acuminate; cells elongate.....9. *algarvicus*
  { Leaves broadly pointed; cells isodiametric.....6

6 { Plant small; border narrow, colourless.....7
  { Plant taller; border strong, coloured.....9

7 { Capsule incurved, cernuous.....4. *incurvus*
  { Capsule erect (or inclined), symmetric.....8

8 { Autoicous; seta very short; ls. more or less uniform.....2. *viridulus*
  { Dioicous; minute; upper ls. longer and narrower, ensiform...3. *pusillus*

9 { Ls. bluntly acuminate, border yellowish, cells rather lax, not incrassate.....7. *crassipes*
  { Ls. usually obtuse, nerve and border reddish, cells smaller, incrassate.....8. *rufulus*

10 { Plant minute, with only 3 or 4 pairs of leaves; seta terminal...1. *exilis*
   { Plant rather tall, with several pairs of leaves.....11

11 { Nerve excurrent in apiculus; seta from base of stem.....15. *taxifolius*
   { Nerve ceasing below apex.....12

12 { Ls. entire, or obscurely toothed near apex.....13
   { Ls. sharply toothed near apex, usually with paler marginal band.....14

13 { Ls. scarcely 1 line long; seta terminal.....10. *osmundoides*
   { Ls. 2-3 lines long, very numerous.....12. *polyphyllus*

14 { Cells obscure, about 6-8 μ; marginal band conspicuous.....14. *decipiens*
   { Cells clear, 10-18 μ; marginal band usually less marked.....15

15 { Ls. ligulate, long; cells conically papillose.....11. *serrulatus*
   { Ls. oblong; cells scarcely prominent.....13. *adiantoides*

1. Fissidens exilis Hedw. (*F. Bloxami* Wils.) (Tab. XVI. C.).

Minute, gregarious. Stem about 1 line long, simple, procumbent; leaves *in 2–4 pairs*, the lower very small, upper longer, oblong-ligulate, at apex acute or obtusely acuminate, *not bordered*, nerve rather thick, reaching to the apex; sheathing laminae rather short, inferior lamina gradually narrowing downwards, *ceasing distinctly above the insertion of the leaf;* cells pellucid, 10–12 μ wide, more or less regularly hexagonal, the marginal smaller in a regular series, with the transverse walls somewhat projecting so that the margin is *regularly crenulate*, usually more strongly so on the sheathing lamina. *Fruit terminal*. Capsule minute, erect, symmetrical, elliptic, on a *red* seta rather long for the size of the plant (2–3 lines); lid conical rostellate, *almost or quite as long as the capsule*. Male flower minute, on a short radical or separate stem.

HAB. Woods and shady banks. Not common. Fr. winter.

One of the smallest species, and often more conspicuous from the red tinge of the setae than from the stem and leaves. Under the microscope it comes nearest in structure to *F. viridulus* var. *Lylei*, but that plant always has a distinct border of narrow cells to the sheathing laminae, and usually shows indications, in other parts of the leaf-margin, of a similar structure, of which there is no trace in the present plant; it cannot, thus examined, be mistaken for any other species. The cells also are larger and more pellucid than in the allied species. In the field the longer, red seta will distinguish it from the above plant, and from other forms of *F. viridulus*, the erect capsule from *F. incurvus*, and the small size from most of the other species; *F. pusillus* is more difficult to distinguish, but has usually a paler seta, and more numerous leaves, the uppermost pair distinctly longer.

The apex of the sheathing laminae in *F. exilis* is upon or close to the nerve, instead of, as usual in our species, at or near the margin; this, together with a narrowing of the leaf at that point, gives it a characteristic appearance (see fig. 1), which is scarcely shared by our other species, except sometimes by *F. viridulus* var. *Lylei*.

2. Fissidens viridulus Wahl. (*Dicranum viridulum* Swartz) (Tab. XVI. D.).

Very small, closely gregarious, bright green. Stems longer than in the last, the leaves usually more numerous, in 4–8 pairs, broader, oblong-lanceolate, acute, the sheathing laminae longer, *inferior lamina reaching to the insertion or nearly so*, nerve reaching apex, *leaves bordered* with a very narrow cartilaginous thickened margin of narrow-linear cells without chlorophyll, which becomes less distinct at the apex or disappears, often giving place to a few minute and obtuse denticulations. Areolation slightly smaller than in the last, about 8 μ wide. Calyptra occasionally entire at base. Capsule on a *short terminal* seta (about 2 lines), *erect and symmetrical*, more rarely inclined, occasionally slightly unequal, oval; lid conical-rostellate, short. Male inflorescence as in the last, occasionally synoicous.

Var. β. *Lylei* Wils. (*F. pusillus* var. *Lylei* Braithw. Br. M. Fl. p. 68; *F. exiguus* Sull., op. cit. p. 81). *Minute.* Leaves in 3–6 pairs, less acute, *border wanting except on the sheathing laminae* where it is usually distinct, or very faint on other parts of the leaf; capsule erect, or slightly inclined, *short*, oval.

HAB. Clay banks, and rocks in shady places. Frequent. The var. β rare. Fr. winter.

This and the two following species are so closely allied, and are, indeed, separated by so few, unimportant characters, that the true positions of their various forms are very difficult to define, and, as has frequently been observed, it is doubtful whether they should not properly be united under a single specific type. The main points of difference between this and the next are the broader leaves in the present plant, more or less uniform in length in the upper part of the stem, and the somewhat larger size; the inflorescence, too, is usually autoicous, while in that species the male plant is generally separate from the female and thus the plant is dioicous. All these characters, however, are variable.

The var. *Lylei*, which is by several authors considered a separate species, is remarkable for its almost total absence of border to the leaves; I have, however, found several intermediate forms growing in the same localities, and in *F. viridulus*, indeed, the border is far from being uniform, and I have gathered specimens otherwise typical in which the border in the inferior lamina becomes very narrow and almost obsolete. I am compelled, therefore, to consider it as only a varietal form. The cells of the var. *Lylei* are, sometimes at least, slightly larger and more pellucid than in the type. I do not find the lid, as Mitten describes it, longer than in *F. pusillus*. Roth, to whom I sent specimens of our British plant, did not consider them identical with ***F. exiguus*** Sull.

3. Fissidens pusillus Wils. (Tab. XVI. E.).

Closely resembling the last, but with the *leaves much narrower and more acute, the uppermost pair especially being often much elongated*, and slightly falcate in outline, the border slightly stronger, the inflorescence *more frequently dioicous*. Capsule *erect or inclined;* lid shortly rostellate. Peristome inserted below the mouth.

Var. β. *madidus* Spruce (*F. minutulus* Sull., Braithw. Br. M. Fl., p. 81). Rather taller, with *more numerous,* longer and narrower leaves. Capsule rather narrower, *lid longer, obliquely rostrate*, sometimes as long as the capsule. Usually, but not always, *autoicous*.

HAB. Shady rocks, principally sandstone, occasionally on chalk. Not uncommon. The var. β on dripping rocks, rare. Fr. autumn.

The long, narrow, very acute leaves distinguish this plant from *F. viridulus*, but specimens may often be found with the leaves broader and more approaching that plant. The cells are usually a little larger and more pellucid in *F. pusillus*. The brown radicular tomentum from which the stem springs is often very copiously produced and conspicuous. It is rather curious that whereas *F. viridulus* is found on no particular matrix, the var. *Lylei*

seems to be almost confined to chalk, while *F. pusillus* prefers sandstone rocks. I have found a very small plant on the oolitic limestone in Northamptonshire, and on the soft limestone of Malham, Yorkshire, which I can only refer to the present species, with smaller, still narrower leaves than the type, and with the border very faint and occasionally almost obsolete. It constitutes indeed a very parallel form to the var. *Lylei* of the preceding species, and is with difficulty distinguished from it. Mr. Nicholson sends me the same plant from Offham, Sussex.

4. Fissidens incurvus Starke (Tab. XVI. F.).

Resembling *F. viridulus*, but rather larger; leaves *broadly oblong-lanceolate*, rather obtuse and apiculate, narrowly bordered, more widely at base; seta *longer*, flexuose, bright red, capsule *cernuous or horizontal, unequal, often arcuate*, oval or very shortly cylindric, larger. Male flower on a very short basal branch.

HAB. Clay banks, etc. Frequent. Fr. winter.

The form of the capsule is almost the only distinguishing feature between this and *F. viridulus*; in its typical form it is quite a different looking plant, but forms occur with shorter, less curved capsules, and these must be looked upon as intermediate links. The fruit-stalk is usually taller, of a brighter red; when in fruit and closely tufted the plant bears a superficial resemblance to *Dicranella varia*.

M. Potier de la Varde, who has recently devoted much study to the smaller species of Fissidens, has established the fact (cf. Rev. Bryol, vol. 41, pp. 85, 94) that the plants united under the name *F. tamarindifolius* (var. β of Ed. II, and Tab. XVI. F) do not form a single type, whether specific or varietal, but include parallel forms of at least four distinct species, one being *F. viridulus* and another *F. bryoides* forma *inconstans*. It is clearly a state merely, produced by certain conditions of environment.

5. Fissidens bryoides Hedw. (*Hypnum bryoides* L.) (Tab. XVI. G.).

Very densely gregarious or tufted; dark green, ¼–1 inch high. Leaves in few or many pairs, oblong-lingulate, abruptly acuminate or rather obtuse and apiculate; *border strong*, especially on the sheathing laminae; at apex continuous and confluent with the nerve or becoming faint and almost disappearing, with a few obscure denticulations; *inferior lamina distinct to base*. Cells about the same as in the three previous species, obscure, rounded-hexagonal, *8–10 μ wide*. Autoicous; *male inflorescence conspicuous in the axils of the leaves*, the antheridia naked or more frequently bracteate. Seta red, *terminal*, capsule *erect, symmetrical;* lid acutely conical, peristome highly papillose.

Var. β. *intermedius* Ruthe. Leaves less acuminate, with shorter and wide points, *the inferior lamina not continued to base*, often ceasing half-way down the leaf, *border narrower*, sometimes almost obsolete on the superior and inferior laminae; male flowers very minute and inconspicuous.

Hab. Clay banks, woods, etc., common. The var. β, Sussex; Dublin. Fr. winter.

The axillary male flowers form the character by which this species is most readily recognised from its allies; these are, however, sometimes very minute, and very rarely the male flower is found on a radical branch, according to Braithwaite; in such cases it is known from all the preceding species by its larger size, more distinct border, symmetrical capsule, and continuous, almost decurrent inferior lamina of the leaves; the nerve also is as a rule more percurrent, usually passing into the apiculus. *F. inconstans* Schp., found by Boswell in Oxfordshire, and later in other localities, is now generally admitted to be a form or sport rather than a permanent variety, far less a separate species; and this is supported by the fact that similar variations occur in other species, *e.g.*, *F. incurvus*. In this form the fruit is sometimes terminal, sometimes lateral, the two conditions sometimes occurring on the same stem; at other times it is basal, while the position of the male flower is equally variable. In other respects it is similar to *F. bryoides*.

The var. *intermedius* is peculiar in habit, the short inferior lamina giving it a very singular appearance.

F. Orrii Lindb. (*F. tequendamensis* Mitt.) must, I think, undoubtedly be excluded as an introduction; its main feature is the longly excurrent nerve.

*** Fissidens Curnowii** Mitt. (*F. bryoides* var. *caespitans* Schp. Syn.) (Tab. XVI. H.).

Taller, *1–2 inches*, soft, caespitose, often very densely and compactly tufted, *bright glaucous green* above, pale red or whitish below; *stems clothed with red radicles*. Leaves *very numerous*, rather narrower and often more acute; the border variable, but, with the nerve, usually strong, white and shining when dry. Capsule small, *slightly inclined and unequal*, often hidden by the upper leaves of the innovations.

Hab. Cliffs, banks, and caves, principally near the sea; rare. South-west England; North Wales; North of Ireland.

Very noticeable in size, colour, and mode of growth, of a more delicate texture than *F. bryoides*, and with the capsule distinctly asymmetric; I do not, however find the other characters sometimes given, as to width of limb, form of leaf, etc., by any means constant. I have also several times found intermediate forms difficult to determine in the absence of fruit. Mitten places it under the Section with the "male flower either basal or terminal," but in all the specimens I have examined (some of them plants of Curnow's own gathering and verified by Braithwaite) they are axillary, and no less conspicuous than in *F. bryoides*. The presence of abundant radicles on the stem is an unusual feature in this genus.

When young the bright pale green plants form dense, rounded depressed tufts (whence Schimper's varietal name), and the stems scarcely show at that time the special features distinguishing the plant in its more mature condition, though markedly differing from *F. bryoides* in colour and compact growth. Instead of dying down annually and innovating only from the base, as with *F. bryoides* and most of our small species, the stems continue to grow terminally, and innovate laterally especially below the perichaetium, thus becoming perennial; while the lower part of the stems, closely compacted together, and interwoven by purple radicles, give the interior of the tufts an almost corky consistency in the best developed forms.

6. Fissidens rivularis Spruce (Tab. XVI. I.).

Allied to *F. bryoides*, but taller, ½–1 inch high, dull green, *not radiculose*. Leaves *long*, crowded, elongate-lingulate, broad at apex or narrowly acute; *border very thick* and yellowish, continuous to apex, as is also the nerve, which runs out into a point, *forming with the borders a stout mucro;* areolation *very dense and opaque*, distinctly smaller than in *F. bryoides*, *6–8 μ wide*, not incrassate. Capsule on a terminal *slender flexuose seta*, erect or slightly inclined, symmetrical, similar to that of *F. bryoides*. Male flowers axillary, as in the latter species.

HAB. Wet rocks by springs and waterfalls. Very rare. Fairlight Glen, Hastings; S. Devon. Fr. winter.

A very distinct species, separated from the following ones by the axillary male inflorescence and the minute areolation, from *F. bryoides* by the more robust habit, the smaller, opaque, chlorophyllose cells, and the very thick, solid border. *F. Curnowii* is a more delicate plant with narrower border and thinner, more pellucid areolation. The strong border and nerve are obvious with a lens, especially in the dry state, but it would be difficult to distinguish *F. rivularis* in the field from *F. rufulus* and *F. crassipes*, except perhaps by the stout rigid mucro of the leaves, which are wanting in the red tinge so often found in those plants.

According to my experience, the fruit is only just ripe in January. The plant appears to have become destroyed in Holmes' original station, but has turned up in several other spots in Fairlight Glen; and has been further collected by Mr. G. T. Harris near Sidmouth, so that fortunately it is not likely to be lost.

7. Fissidens crassipes Wils. (*F. viridulus* var. *fontanus* Braithw., Br. M. Fl., p. 71) (Tab. XVI. J.).

In *dark green* dense tufts, often submerged, *tall*, ½–2 inches long, rather rigid, often emitting tufts of red radicles from the axils of the leaves. Leaves oblong-ligulate, *shortly and obtusely acuminate* at summit, *border thick*, vanishing below the minutely serrulate apex, often irregularly nodulose or denticulate, frequently tinged with red; nerve thick, reddish, *vanishing in the apex*. Dorsal lamina usually ceasing above base. Sheathing laminae mostly less than half length of leaf. *Cells large, 12–18 μ wide*, rather lax and irregular, *with thin walls*, deep green with chlorophyll and opaque. *Dioicous*. Male inflorescence terminal, conspicuous. Fruit *terminal*, on a short, thick, reddish flexuose and often geniculate seta, erect or inclined; lid acutely conical. Spores twice as large as in *F. viridulus*.

HAB. Stones in streams, especially in calcareous districts. Not common. Fr. late autumn.

Although by many authors this is united to *F. viridulus*, it appears to be a good species, differing not only in the much larger, opaque cells, but also in the form of the leaf apex, which in this is bluntly triangular, sometimes

almost rounded, but in the smaller plant is acute and often apiculate. The seta is also thicker, and this must not be looked upon as a necessary consequence of its aquatic habit, since in *F. rivularis*, equally aquatic, it is particularly slender. It is much nearer *F. rufulus*, and indeed can sometimes hardly be separated except by the larger, thin-walled cells. I find it abundantly fruiting in Northamptonshire with the capsules exceedingly polymorphous both as to form and direction, sometimes being arcuate as in *F. incurvus*.

The apex of the leaf is frequently eroded and may thus appear to be more obtuse than is really the case.

8. Fissidens rufulus B. & S. (Tab. XVI. K.).

Resembling the last, but with the leaves slightly shorter, *broader and more obtuse*, almost always with some tinge of red, especially on the nerve and border of the older leaves. Dorsal lamina usually reaching base. Sheathing laminae mostly above half length of leaf. Cells *smaller, somewhat incrassate*, more regularly hexagonal, rather obscure but less so than in *F. crassipes*, Fruit terminal on a paler, more slender seta, the capsule more regular ; lid variable.

Hab. Stones in mountain streams ; very rare. Fruit late summer, rare.

The smaller, incrassate cells are the chief character by which this may be known from the last ; but certain forms are in my opinion exceedingly difficult to determine with certainty. As a rule the leaves in *F. rufulus* are shorter and more obtuse, the border more markedly red ; but these characters appear at times in the other species. The varying lengths of dorsal lamina and sheathing laminae, emphasised by Limpricht, are certainly not constant. The fruiting characters must also be considered untrustworthy, as however constant they may be in the present plant (though there is considerable discrepancy in the various descriptions) similar forms may with certainty be looked for in the variable *F. crassipes*. Fruiting specimens gathered by the Rev. H. G. Jameson in the R. Wharfe (from which the above description of the fruit is taken) do not agree with the descriptions of either Braithwaite or Boulay ; they have the cells however less incrassate than usual, and possibly are not typical *F. rufulus*, but they certainly cannot be referred to the last or to any other of our species. The two species certainly require further elucidation.

9. Fissidens algarvicus Solms (Tab. LII. A.).

Minute ; gregarious or laxly tufted. Stems about 1 line long, sterile with numerous pairs of very short, rather crowded, equal leaves, fertile with about 4-5 pairs of leaves, the lower very small, the upper larger, *lingulate-lanceolate, longly and very acutely acuminate*. Sheathing lamina about half the length, dorsal lamina narrowed below and *not reaching, or scarcely reaching the insertion ;* all margins with *stout border*, that of the sheathing lamina especially wide ; nerve stout in proportion to the size of the leaf, reaching apex and there confluent with the marginal borders, forming an acute cuspidate point. Upper cells *lax, irregularly elongate-*

hexagonal, often twice as long as wide, 5–8 μ wide, pellucid, with rather thin-walls; those of the sheathing lamina *much larger, irregularly rectangular*. Dioicous. Seta 1½–2 lines long; capsule *minute*, erect, ovate, lid conical. Peristome teeth *highly hygroscopic*, widely spreading when dry, inflexed and enclosed within the mouth of the capsule when moist; lamellae internally *very high, cristate*. Spores 13–18 μ.

HAB. On shady banks, very rare. S. Devon; Gloucestershire. Fr. winter.

A very distinct species, only known elsewhere from the south and west of France, and Portugal. The narrowly and acutely tapering leaves with strong borders, and the lax, elongate, not isodiametric cells, especially enlarged and elongate at the base of the leaf will easily distinguish it. The beautifully cristate peristome teeth are characteristic of a large number of the smaller, mostly tropical species of the genus. They are only to be satisfactorily seen in the dry state, the teeth disappearing in the cavity of the capsule immediately upon moistening.

[**Fissidens exsul** *Dixon* in Journ. of Bot. 1910, p. 147, is a nearly allied species to *F. algarvicus*, differing in the more robust habit, larger, broader leaves, larger, more isodiametric upper cells, 8–14 μ wide, the longer seta, inclined capsule, and much smaller spores. The peristome is of the same nature. It has only been found in palm-houses in the Botanic Gardens at Dublin, and like the nearly related *F. tequendamensis* is clearly an introduced species, with no claim to be considered native.]

10. Fissidens osmundoides Hedw. (*Dicranum osmundoides* Sw.) (Tab. XVII. A.).

Tall, *in dense tufts*, very compact at the base, *2–6 inches high*, bright or yellowish green; stems slender, branched, radiculose. Leaves *short*, broadly lingulate, abruptly narrowed at apex and apiculate, or broadly pointed; sheathing laminae more than half the length of the leaf, broad; inferior lamina reaching nearly to the base of the leaf, often abruptly ceasing; areolation larger than in any of the foregoing species, *14–20* μ wide (but often much smaller even in the leaves from the same stem), more regularly hexagonal-rounded, *incrassate*, a single row at margin smaller and often paler or discoloured, but *without a thickened border of narrow* cells; a row or two on each side of the nerve also often paler and more pellucid; *nerve ceasing some distance below the apex;* margin *faintly and regularly crenulate* with the projecting cells, which are also turgid and prominent on the surface of the leaf. *Seta terminal*, purple; capsule rather small, narrow-oblong, erect or slightly inclined, thick-walled, dark coloured; calyptra mitriform, lobed at the base, or cucullate; lid long, rostrate. Dioicous; male flower terminal.

Hab. Wet rocks and mountain slopes. Not common. Fr. summer.

Quite distinct from any of the other terminal-fruited species in the tall, slender growth and non-bordered leaves. It is more likely, in the absence of fruit, to be confused with one of the following species, especially *F. taxifolius* and *F. decipiens*, the latter of which it much resembles in habit; the former will be easily known by its shorter stems and narrower leaves with the nerve percurrent or even excurrent; and *F. decipiens* by its longer, serrated leaves with broad margin of paler cells, and much smaller areolation.

The cells in this species vary considerably in size, even on the same stem, but ordinarily they are of about the dimensions given above, or even larger in the lower leaves of the stem; the smaller cells appear, indeed, to be confined to the upper leaves.

11. Fissidens serrulatus Brid. (Tab. XVII. B.).

Loosely tufted, pale green, *robust;* stems simple or branched at the base, 1-3 inches high, erect, rather rigid. *Leaves very large*, crowded, longer towards the top of the stem, *broadly lingulate*, sometimes ¼ inch in length, straight, solid; at apex *shortly acuminate or acute*, the tip often irregular and turned to one side, *unequally serrate;* nerve rather thick, vanishing at apex; cells rather large, 10–15 μ, incrassate, often in two strata; each cell prominent, on both faces of the leaf, in a *high, conical* protuberance; hexagonal-rounded, at margin with *about four rows of thinner, paler or yellowish cells*, less chlorophyllose and more incrassate, *forming a more or less distinct pale marginal band to the leaf*, regularly crenulate; inferior lamina wide and ceasing abruptly at base. Dioicous; male flowers axillary or terminal, large, conspicuous; *fruit terminal*, seta stout, yellowish, flexuose; capsule inclined, oblong, dark brown, thick-walled.

Hab. Damp banks by streams, and rocks. Very rare; near Penzance.

The male plant alone has been found in this country. It is a very rare European species, but grows and fruits abundantly in Teneriffe. From its large size it can only be confused with the following species, or with *very* robust forms of *F. adiantoides;* the latter, however, very rarely equals it in the length of the leaves, and the cells are larger and much less papillose; the texture, also, is softer and less rigid. *F. polyphyllus* differs in the characters detailed under that species, of which this is by some writers considered a variety.

12. Fissidens polyphyllus Wils. (Tab. XVII. C.).

Very robust and tall, *3–12 inches long, deep green*, rigid, stems often prostrate or pendent, radiculose. Leaves crowded, sometimes slightly falcate, incurved and flexuose when dry, *narrowly lingulate-lanceolate*, very long, *without any distinct band of marginal cells, obtusely pointed*, minutely crenulate all round, or with a few obscure serratures at point; nerve thick, rather broad; inferior lamina more narrowed at base, less abruptly

ceasing ; cells *smooth* or only faintly protuberant ; near the nerve 12–16 μ wide, gradually decreasing in size towards margin, a single marginal row usually very small, 8–9 μ. Dioicous ; male inflorescence as in the last ; fruit lateral, near the top of the stem ; capsule as in *F. serrulatus*.

HAB. Wet rocks, in and by streams. Very rare, but occasionally abundant where it occurs. Cornwall ; Devon ; N. Wales ; Ireland. Fruit not found in Britain.

A still finer plant than the last ; it has only recently been found in fruit, in Finisterre. The narrower leaves without the pale marginal band, and with almost entire less acuminate apex, and the papillose cells, separate it from the last, as do also the habit and colour ; these characters with the different position of the female flower appear amply sufficient to warrant its retention as a species. I have found the nerve in *F. polyphyllus* constantly broader and less well-defined than in *F. serrulatus*.

13. Fissidens adiantoides Hedw. (*Hypnum adiantoides* L.) (Tab. XVII. E.).

Deep or yellowish green, 1–4 inches high, rarely up to 9 or 10 inches, variable in size and habit, sometimes slender and short-leaved as in *F. osmundoides*, sometimes robust and rivalling *F. polyphyllus*. Leaves without a thickened border, usually crowded, broadly oblong-lanceolate, acute or shortly acuminate, crisped when dry, especially at the tip, inferior lamina broad and usually ceasing abruptly at base ; *margin crenulate, towards apex more distinctly and unequally serrate ; nerve vanishing at apex*. Cells rather large, usually *12–18* μ wide, 2–4 rows at edges often a little paler, *forming an obscure marginal band*, which is, however, variable and not always present, most distinct in the older leaves. Autoicous or dioicous ; *fruit lateral, from the middle of the stem*, several arising from the same stem ; seta stout, red, flexuose, long ; capsule horizontal and arcuate, or erect and symmetrical. dark-coloured ; lid long-beaked. Male flowers axillary, small.

HAB. Bogs, wet rocks on mountains, etc. Common. Fr. winter.

Very variable, but in its ordinary forms recognised at sight by its larger size, etc., from all the allied species but *F. decipiens ;* from this it is known by the larger cells and less distinct marginal band ; from *F. osmundoides* and *F. taxifolius* by the larger, more serrate leaves, and from the latter species also by the shorter nerve.

In grassy, drier spots the plants are dwarfed, the stems short, the leaves small, and often less distinctly bordered with pale cells ; in these cases the cells are often smaller, sometimes as little as 8-10 μ. *F. collinus* Mitt. appears to belong here, but I am unable to find any constant characters that would warrant its being retained as a species, or, indeed, even as a variety. This form occurs frequently on the chalk downs of the south coast, but even among such chalk plants of identical habit there does not appear to be any uniformity in the size of the cells.

These smaller forms are sometimes difficult to separate from *F. decipiens*, which occurs, though rarely, in similar dry grassy stations ; as a rule the latter plant has more obscure areolation, and more distinctly bordered leaves.

14. Fissidens decipiens De Not. (Tab. XVII. F.).

Intermediate in size between *F. adiantoides* and *F. taxifolius*, usually more slender than the first and taller than the last, but variable ; in dense dull green or blackish erect tufts. Leaves crowded, lingulate, acute but not acuminate, crenulate at margin, *in the upper half coarsely and unequally serrate ; cells smaller, 6–8 μ*, more obscure than in *F. adiantoides*, *incrassate*, here and there *bistratose ;* about four rows at margin more incrassate and less obscure, forming a *more distinct pale or yellowish band* round the leaf. Dioicous or autoicous ; female flowers often very numerous, *seta from middle and lower part of stem, short, slender, pale red ;* capsules oval-oblong ; lid rostrate.

Var. *β. brevifolius* Lindb. Leaves crowded, *much shorter, less distinctly serrate*, with a narrower band of pale cells.

Hab. Wet rocks in mountainous countries ; rarely among grass at lower levels. Frequent. The var. *β*, Killarney. Fr. winter and spring.

The distinctly smaller areolation and the more conspicuous band of marginal paler cells chiefly, and in general easily, characterise this species. It is usually but not always distinguishable from *F. adiantoides* by the more slender stems, from *F. taxifolius* by the taller stems and different habitat, shorter nerve and serrate leaves, and from *F. osmundoides* by the serrate apex of the leaf and small cells. Small forms of *F. decipiens* have frequently passed under the name of *F. collinus* Mitt.

15. Fissidens taxifolius Hedw. (*Hypnum taxifolium* L.) (Tab. XVII. D.).

Typically the smallest of the lateral-fruited species, usually less than ½-inch high, rarely exceeding one inch ; dark green, often with a tinge of reddish brown, branched from the base, suberect. Leaves crowded, usually longest in the middle of the stem, oblong-lingulate, broadly pointed and *apiculate with the percurrent nerve*, not bordered ; inferior lamina ceasing abruptly at base ; cells as in the last species, but less opaque and with thinner walls, *marginal cells not distinct*, though those of the outer row are occasionally more pellucid and slightly different in shape, regularly and almost uniformly crenulate or finely serrulate from base to apex. Autoicous, male flowers on short basal branches. Seta red, *from near the base of the stem*, flexuose, rather long ; capsule equal and suberect or variously inclined and gibbous, sometimes almost pendulous ; lid longly rostrate ; peristome large, bright red.

HAB. Woods, roadsides, etc., usually on clay. Common. Fr. winter.

Readily known, in its usual form, from the larger species by its shorter stems and leaves; under the microscope the percurrent or excurrent nerve and entire absence of marginal band easily determine it. It is not a variable species except in the form and direction of its fruit. A tall form, however, occurs, probably deserving of varietal rank, but still *sub judice*. In this form, sometimes at least, the setae are produced from the middle and upper part of the stem.

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29. OCTODICERAS Brid.

Aquatic plants, with flaccid, floating stems. Stems *without central-strand*, branched, with short deciduous branchlets. Leaves without cartilaginous border, the sheathing laminae *only* $\frac{1}{3}$ *or* $\frac{1}{4}$ *the length of the leaf*. Fruit on a *very short seta*, often deciduous. Calyptra conical, undivided, very small. Capsule small, *without stomata*.

DERIV. ὀκτω (okto) eight, and δικερας (dikeras) a double horn, erroneously based on the supposition that the peristome teeth were in eight pairs.

1. Octodiceras Julianum Brid. (*Fontinalis Juliana* Savi; *Conomitrium Julianum* Mont., Schp. Syn.) (Tab. XVII. G.).

Stems extremely slender, capillary, *flaccid*, *much branched*, 1–3 inches long, rarely 4 inches, dark green. Leaves distant, spreading, *long* (1–2 lines) *and very narrow*, tapering to a sub-obtuse point; margin *entire*, *without any border*; dorsal lamina ceasing above base, nerve *vanishing* at some distance below apex. Cells 14-20 μ, becoming smaller towards margin, thin-walled, irregularly hexagonal.

Capsule *scarcely raised above the perichactial bracts*, on a short stout seta, elliptical, erect, symmetrical; lid as long as the capsule, rostellate. Calyptra fringed at base. Peristome imperfect, of 16 short truncate teeth.

HAB. Attached to stones and wood in streams. Very rare. R. Severn, near Bewdley (*J. B. Duncan 1901*); Shrewsbury (*Duncan and Hamilton, 1905*); Henley on Thames (*P. Richards, 1921*). Fruit rare, ripe in spring and summer; not at present found in Britain.

Mr. Duncan's investigations show that this interesting and very distinct addition to our Flora is not a mere casual, but may be looked upon as a true native, as might be expected since it occurs in streams throughout the greater part of Central Europe. This is confirmed by the subsequent records. It is so delicate and flaccid that it is easily overlooked. It is said to be not unusual for the capsule to fall off and new plants to spring from the margin of the calyptra.

Order VIII. GRIMMIACEAE.

Plants of varying habit, most frequently in dense tufts or cushions. Leaves in many rows, crowded, frequently hyaline-tipped, ovate-lanceolate or rarely linear-subulate ; upper areolation small, usually opaque and often 2-or 3-stratose, lower longer, with the walls frequently sinuose. Capsule on a straight or arcuate short seta, symmetrical or very slightly unequal, oval or cylindric. Calyptra mitriform or cucullate, sometimes papillose, smooth or sulcate. Peristome single, resembling that of Dicranum but without vertical striae, less regularly cleft, the *exterior* plates usually thickest and often transversely trabeculate. Male flowers gemmiform. Almost entirely confined to rocks.

The Order, as above defined, forms an exceedingly natural one ; there is a great uniformity in habit, areolation, fruit, and especially in peristome. The peristome of Orthotrichum and its allies is of an entirely different character, and in other respects nothing is sacrificed by separating the two Orders, an arrangement which will also probably be found by the student to simplify their study.

It is a curious fact, and one which a beginner will find worth remembering, that with the exception of *Rhacomitrium lanuginosum* and *R. canescens*, every British species is a rock growing plant.

The leaves of the species of Grimmiaceae, as contrasted with those of most Orders, are extremely hygroscopic, that is to say while undergoing considerable change of form when becoming dry, they very quickly recover their normal shape when moistened, usually from twisted or incurved rapidly becoming recurved, and then returning to their normal, more or less straight position. This character they hold in common with the Orthotrichaceae, the Andreaeaceae, and many of the Tortulaceae.

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30. GRIMMIA Ehrh.

Mostly short-stemmed mosses, growing in close cushions or tufts on rocks ; stems dichotomous. Leaves crowded, more or less lanceolate, *usually hyaline-pointed*, margin frequently thickened, almost always entire ; areolation short and often opaque above. Seta *arcuate or straight*. Calyptra *smooth* ; capsule *oval*. Peristome teeth 16, cleft at apex or entire, lanceolate.

The species of Grimmia are for the most part recognisable as belonging to that genus at first sight, but are difficult of determination specifically. When the fruit is present it forms a material aid to identification, but it is frequently wanting, indeed in some species it has not yet been discovered, and the determina-

tion then usually rests on minute differences of areolation, difficult to define ; and a microscopical examination of specimens, in some of the critical species, is imperative, and not always decisive.

It should be noted that the hyaline leaf-point is not, as in Barbula, formed by the excurrence of the nerve, but by the prolongation of the lamina ; the nerve being lost, in most of the species, in the apex, at the base of the hyaline point. The leaves are extremely hygroscopic, and in most cases when wetted immediately become squarrose, then slowly take their normal, more or less erecto-patent position. In examining the basal areolation, mature leaves must be chosen, as in the young leaves the cells often present a very different appearance, as do those of the perichaetial bracts.

The margin of the leaves is often recurved, and the presence or absence of this character affords a useful and a fairly constant distinction between species. It should be noted that in many, if not in most cases, it is only *one* margin that is recurved, the other being plane. The transverse sections in the Plates are taken from about the middle of the length of the leaf ; the margin being often plane at the summit and towards the base, while recurved in the middle portion.

DERIV.—After Grimm, a physician and botanist of Gotha.

1 { Ls. all without hyaline points....2
  { Upper ls. with hyaline points....6

2 { Nerve 2-winged at back above ; plant tall....*14. patens*
  { Nerve not winged at back....3

3 { Ls. obtuse, cucullate, margin erect ; dioicous .... *24. unicolor*
  { Ls. more or less bluntly pointed, not cucullate....4

4 { Basal cells elongate and sinuose ; dioicous....*23. atrata*
  { Basal cells short ; monoicous ; capsule immersed....5

5 { Ls. with revolute margin, lanceolate ; (vars. of)....*1. apocarpa*
  { Ls. with erect margin, narrow, nerve strong....*2. maritima*

6 { Hyaline points short, lower ls. often muticous....7
  { Hyaline points of upper ls. forming a longish hair....12

7 { Capsule immersed ; monoicous....8
  { Capsule exserted ; dioicous....9

8 { Plant small, dense soft, dull-green ; peristome teeth cribrose...*1*. conferta*
  { Plant larger, loosely tufted, coarser ; peristome teeth sub-entire *1. apocarpa*

9 { Ls. much crisped or twisted when dry....10
  { Ls. not (or scarcely) crisped or twisted....11

10 { Ls. very curled when dry ; basal cells thin-walled....5. *incurva*
   { Ls. spirally twisted when dry ; basal cells incrassate....*7. torquata*

11 { Upper ls. long, cells quadrate almost to base....12
   { Ls. short, patent, cells sinuose, elongate at base....*22. elongata*

12 { Leaves secund, with a short hair-point....*13. Hartmani*
   { Leaves recurved-squarrose, not secund, usually muticous...*13*. retracta*

13 { Capsule immersed ; monoicous ; plant very small....13
   { Capsule exserted, or fruit unknown....14

14 { Peristome absent ; ls. ovate, nerve vanishing.....*3. anodon*
Peristome present ; ls. usually obovate, nerve running out into the hair.....*4. crinita*

15 { Leaf margin erect (except *ovata*), seta straight (except *arenaria*).....15
Seta curved when moist (or fruit unknown) ; margin recurved, sometimes on one side of the leaf only.....21

16 { Seta straight.....16
Seta curved.....*15*. arenaria*

17 { Ls. oblong-lanceolate, contracted to a long, rough hair.....*20. leucophaea*
Ls. lanceolate, more or less tapering 17

18 { Basal cells rectangular, scarcely thickened, not sinuose.....18
Basal cells narrow, incrassate, more or less sinuose.....20

19 { Lid conic, obtuse ; autoicous.....19
Lid rostrate ; dioicous ; (calyptra cucullate ; basal cells short).....*18. montana*

20 { Calyptra mitriform ; capsule pale ; lower cells elongate.....*15. Donnana*
Calyptra cucullate ; capsule brownish ; basal cells short.....*19. alpestris*

21 { Dioicous ; lid rostrate ; calyptra cucullate.....*17. commutata*
Autoicous ; lid rostellate ; calyptra mitriform.....*16. ovata*

22 { Hair-point very rough.....22
Hair-point smooth or slightly roughened only.....24

23 { Ls. broadly pointed ; basal cells short.....*21. homodictyon*
Ls. narrowly tapering ; basal cells elongate.....23

24 { Plant robust ; capsule 8-furrowed ; autoicous.....*11. decipiens*
Plant smaller ; capsule almost smooth ; dioicous.....*10*. Muehlenbeckii*

25 { Basal cells shortly rectangular.....25
Basal cells elongate.....29

26 { Monoicous ; plant in dense rounded cushions ; ls. rather suddenly contracted to a hair.....26
Dioicous ; plant loosely tufted ; ls. tapering at point.....27

27 { Calyptra mitriform ; lid beaked ; ls. bistratose at margin...*8. pulvinata*
Calyptra cucullate ; lid blunt ; margin unistratose.....*9. orbicularis*

28 { Plant coarse and robust, cells mostly more or less sinuose.....*11*. robusta*
Cells not (or scarcely) sinuose.....28

29 { Ls. subsquarrose, hair roughish..... *10*. subsquarrosa*
Ls. narrow, patent, point smooth.....*10*. Stirtoni*

30 { Plant tall, dull green ; upper cells opaque.....*12. elatior*
Plant smaller, yellowish or greyish green.....30

31 { Ls. spirally twisted when dry, narrow ; plant slender.....*6. funalis*
Ls. scarcely twisted when dry, wider at base.....*10. trichophylla*

A. SCHISTIDIUM.

Capsule immersed, on a short, erect seta, wide-mouthed ; columella remaining attached to the lid when the latter falls.

1. Grimmia apocarpa Hedw. (*Bryum apocarpum* L. ; *Grimmia platyphylla* Stirt. in Scot. Nat., No. xxvii, p. 219) (Tab. XVII. H.).

Extremely variable in habit ; in its typical form it makes rather loose, small tufts, with erect rigid stems, about 1 inch high, of a dull olive green or brownish colour. Leaves broadly ovate-

lanceolate, erecto-patent, erect when dry and forming a cuspidate point at the top of the stem, carinate above, margin narrowly recurved; the point entire or obscurely notched; nerve vanishing at or below apex, slightly roughened behind, terete at back; *hair-point variable, usually short*, hardly ¼ length of leaf, slightly rough, flattened, sometimes wanting; lower cells rectangular, rather short and firm, then quadrate, with the walls slightly sinuose, in upper part small, rounded or quadrate-hexagonal, incrassate, opaque; usually bistratose at margin, especially marked in vars. β and γ. Perichaetial bracts wider, thinner, with a narrower nerve. Calyptra very small, not reaching below the lid, lobed at the base. Capsule persistent, *oval-oblong, rather thick-walled*, almost concealed by the perichaetial leaves, reddish brown, with a ring of stomata at the base, which are sometimes rather indistinct; lid bright red, straight or oblique, rostellate; peristome teeth inserted below the mouth, large, bright *deep red, entire or slightly perforated, rather solid*, spreading when dry. Columella attached to the lid and falling off with it. Spores 8–14 μ. Autoicous.

Var. β *alpicola* Hook. & Tayl. (*Grimmia alpicola* Sw.). In *small short* tufts, dark or dull green. Leaves *broad*, narrowed to a short *broadly pointed or sub-obtuse apex, without hair-point*, entire or faintly toothed. Nerve *stout*, brown. Cells with slightly thinner walls, *not sinuose*. Perichaetial bracts short, often broad, sub-obtuse and not exceeding the capsule. Capsule rather small, *emergent, shortly elliptical or oval*, wide mouthed and truncate when empty, golden green, thick-walled. Lid with a *short* beak. Peristome large, bright purple red, often perforate. Spores *larger*, 16–20 μ, finely punctulate.

Var. γ. *rivularis* W. & M. (*Grimmia rivularis* Brid. In *large, often floating masses*, resembling *Cinclidotus fontinaloides*. Stems *elongate*, 2–4 inches long, much branched, densely leaved above, *almost naked below*. Leaves *broadly pointed, sub-obtuse, hairless, often toothed at apex*, frequently secund. Nerve *stout*. Perichaetial bracts longer, narrower. Capsule *large, wide-mouthed and hemispherical when empty*, brown. Peristome and spores as in var. β.

Var. δ. *gracilis* W. & M. (*Grimmia gracilis* Schleich.; *Schistidium nodulosum* Stirt. in Ann. Scot. Nat. Hist., xvi, 175; *Barbula chlorophana* Stirt., op. cit., xii, 116). Stems long and *very slender, rigid*, dark *reddish* brown, decumbent. Leaves often secund, tapering, margins strongly recurved, often toothed at apex. Nerve *scabrous at back*. Cells incrassate, sinuose. Capsule and perichaetial bracts *often secund*, capsule rather small, *elongate*, thin-walled.

Var. ε. *pumila* Schp. *Very small and short*, in dense tufts, slender; leaves narrower; capsule *small, thin-walled, oval, with a wide mouth.*

Hab. Stones and walls, common. The vars. β, γ, in and by streams, attached to rocks. The var. δ on boulders, usually by mountain streams. The var. ϵ on mountain rocks. Fr. spring and summer.

The various forms of this common moss are too numerous to allow of detailed description. The hair-points are sometimes wanting, sometimes prolonged and hoary, entire or denticulate; the leaves are variable in form, colour, and direction, the capsule in form and texture; the peristome teeth are entire or more or less perforate, while the habit varies from a dwarf plant, about $\frac{1}{4}$ inch in height, to a robust aquatic form almost rivalling *Cinclidotus fontinaloides* in size and depth of colour. The var. *pumila* forms a transition to the following plant; indeed, forms occur which could not be separated from *G. conferta* except by the slightly more solid, less cribrose teeth.

The vars. β and γ are closely allied to one another, var. *rivularis* being an elongated, robust form of var. *alpicola*; there is a good deal to be said for Limpricht's arrangement, making *alpicola* a distinct species with *rivularis* as its variety. The former is rare with us, and is more at home in glacial streams at high altitudes.

There is much, too, to be said for making var. *gracilis* a sub species of *G. apocarpa*; Hagen however finds numerous intermediate forms, and has no doubt that it is only of varietal rank. *Barbula chlorophana* Stirt. is a remarkable form with recurved leaves quite hairless; if var. *gracilis* were treated as a species or subspecies, Stirton's plant might well take varietal rank under it.

Innovations are formed below the fruit, which soon overtop it, so that, in vars. γ and δ especially, as it persists for several years, it has all the appearance of being lateral, several capsules often appearing one above the other on the same stem.

When the capsules are present this can hardly be taken for any other moss; in their absence the colour, the cuspidate branches, and the shortly hyaline leaf-points make it an easily recognised plant. It is a coarser, more rigid plant than most of the species of this genus.

*** Grimmia conferta** Funck (Tab. XVII. I.).

Resembles *G. apocarpa* var. *pumila*; plants small in dense cushions, greyish green above, rather softer in texture, leaves *small, shortly hair-pointed*; nerve prominent at back of leaf; areolation small. Capsule *thin-walled, ovate-globose, hemispherical after the fall of the lid*; peristome teeth *thin, pale orange red,* variously divided and *perforated, fragile.*

Var. β. *pruinosa* Braithw. (*G. pruinosa* Wils., Schp. Syn.). More robust; leaves broader, the upper with *long, smoothish hair-points*; *capsule longer*; peristome teeth narrower, often reflexed.

Hab. Mountain rocks, very rare; Scotland. The var. β, Scotland; Ireland. Fr. spring.

G. conferta though treated as a species by Braithwaite and most authors, is, I think, too slightly marked and too closely linked with *G. apocarpa* by the var. *pumila* of the latter as well as by its own var. *pruinosa*, to be maintained independently; I can find no constant difference in the form of the leaves or the size of their cells; while the capsule in *G. apocarpa* var. *pumila* is sometimes exactly that of *G. conferta*, and the difference in the amount of

perforation of the peristome teeth is only one of degree. The paler colour of the peristome teeth emphasised by Limpricht is, I think, a character of doubtful importance, but it may have some value. That of the central strand of the stem, distinct in *G. conferta*, indistinct in *G. apocarpa*, whatever its morphological value, scarcely affords a very practical assistance in discriminating the two.

Both plants have a form with obtuse hairless leaves, that of the present one constituting the var. *obtusifolia* of Schimper.

2. Grimmia maritima Smith (Tab. XVII. J.).

In dense *rigid* cushions, yellowish green on the surface, blackish below, 1–2 inches high. Leaves crowded, *stiff*, *solid*, erecto-patent; when dry appressed, slightly and rigidly contorted; rather glossy, elongate-lanceolate, with a strong brownish point, chiefly formed of the nerve, *not hyaline*; margin plane above, slightly reflexed at the base, entire, except at apex, where it is sparingly crenulate-papillose; *nerve strong*, reaching apex or slightly excurrent; cells shortly rectangular and pale at mid-base, (quadrate at margin), soon becoming quadrate, in upper part of leaf rounded-quadrate, opaque, in two or three strata. Autoicous. Perichaetial bracts sub-falcate, nerve excurrent. Capsule immersed in the perichaetium, pale brown, oval-globose, wide-mouthed and turbinate after the fall of the lid; peristome as in *G. apocarpa*, but with broader, more solid, slightly perforated teeth.

HAB. Rocks by the sea; frequent on the west coast, rare on the eastern side. Fr. winter.

G. maritima is easily known by its more rigid habit, narrower solid leaves without hyaline points, strong nerve, etc.; it is one of the very few mosses which can really be called maritime, growing as it often does close to high water mark and within reach of the spray, on siliceous and basaltic, rarely or never on calcareous rocks. It appears to be confined to the northern shores of the Atlantic Ocean.

B. GASTEROGRIMMIA.

Capsule immersed on a curved seta, oval, slightly inflated on one side at base. Leaf margin not recurved.

3. Grimmia anodon B. & S. (Tab. XVII. K.).

In *small cushions*, about ¼-inch high; hoary with the hair-points of the leaves; stems slender, fragile, brownish. Lower leaves small, muticous, ovate-lanceolate, upper larger, *broadly oblong-lanceolate or obovate-oblong, narrowed at apex or obtuse*, concave, apex prolonged into a rather long, flat or terete,

denticulate hair, below which the apex of the leaf, frequently for some distance, is also hyaline, a narrow hyaline band sometimes descending still further at each margin; nerve narrow, *thickened above*, prolonged into the hair-point, but indistinctly. Cells at base lax, long, rectangular, hyaline, with thin walls, above minute, rounded-quadrate, incrassate, chlorophyllose, in regular longitudinal rows; marginal cells in the upper half, and those of a great part of the lamina towards apex *in two layers*. Capsule small, sub-globose, swollen on one side at base, on a very short arcuate seta, thin-walled, *gymnostomous*, wide-mouthed when dry; calyptra very small, *mitriform*, lobed at base; lid large, mamillate. Autoicous.

Hab. Dry rocks in mountain districts; very rare. Arthur's Seat. Near Kendal. Fr. spring.

Although very different from the next species in the fruiting characters, this plant so much resembles it in the foliar organs that is difficult or indeed impossible to recognise it except by the upper cells being in two layers. The nerve is, perhaps, usually more distinct in the hair-point in *G. crinita*, but this is certainly not a constant character. The gradual narrowing of the leaf apex is by no means to be relied on, as leaves are often found quite as obtuse as in *G. crinita*.

4. Grimmia crinita Brid. (Tab. XVIII. A.).

In *close tufts or patches*, grey with the hoary leaf-points, short, but somewhat variable in length. Leaves resembling those of the last species, *obtuse*, the upper broad and concave, obovate, suddenly hair-pointed, the upper part of the elongate point terete, smooth, piliform, consisting of the longly excurrent nerve. *Cells in one layer throughout the leaf*. Seta longer, capsule more symmetrical at base, oval, faintly striate, brown; calyptra rather larger, *cucullate*; lid obtusely conical; *peristome teeth lanceolate*, cleft into two or three divisions, which are often more or less coherent.

Hab. Dry calcareous walls or mortar; very rare. Near Hatton, Warwickshire (*Bagnall*). Fr. spring.

Differs from the last in the more highly developed peristomate fruit; and also in the leaf-cells being in a single layer throughout the leaf.

These two species closely resemble *Coscinodon cribrosus*, but the sulcate leaves, the calyptra, and the cribrose peristome teeth of that plant will easily separate it.

In the regions of the Mediterranean where it flourishes best it forms extensive velvety patches resembling a mouse-skin in appearance.

C. EU-GRIMMIA.

Capsule exserted on a straight or arcuate seta, regular.
* Seta arcuate.

5. Grimmia incurva Schwaeg. (*G. contorta* Schp. Syn.) (Tab. XVIII. B.).

In *short, dense*, rounded cushions, deep green above, *blackish* below. Leaves *strongly twisted when dry, longly linear from a narrow lanceolate base* (about one line long),† with a *very short*, narrow, almost smooth hair-point, faintly and narrowly recurved at margin or plane, opaque in the upper part; nerve terete and well defined below, above obscure, pellucid; cells *elongate-rectangular at base, and hyaline*, above shorter, chlorophyllose; hyaline cells extending in two or three rows at margin higher than in the middle of the leaf base; cells in upper part quadrate-oval, opaque. Dioicous. Capsule small, smooth, oval, on a slightly curved seta, erect when dry, peristomate; calyptra mitriform; lid conical, obtuse. Perichaetial bracts reaching as high as the capsule.

HAB. Siliceous rocks, rare. England; Scotland; Wales. Recently found in abundance on one of the Clee Hills, Shropshire, by the Rev. C. H. Binstead. Fr. rare, spring.

The close dark tufts of this moss with much curled leaves resemble *Dicranoweisia crispula*, and may very easily be taken for that plant; the Grimmia is, however, usually shorter, less glossy, with the leaves not quite so closely crisped when dry, when moist not at all falcato secund, but spreading in all directions and usually somewhat incurved at the point; and the hair-points, when distinguishable with the lens, afford a conclusive distinction. It cannot be confused with any other species of Grimmia, nor, of course, under the microscope, with the *Dicranoweisia*.

6. Grimmia funalis Schp. (*Trichostomum funale* Schwaeg.; *Grimmia Horni* Stirt. in Scot. Nat., No. xxvii. p. 218) (Tab. XVIII. C.).

In dense smooth cushions, very easily breaking up when gathered; *black below*, grey or yellowish green above, stems variable in length, but usually taller than in the last, 1–2½ inches high. Leaves crowded, erecto-patent when moist, when dry *appressed and spirally enrolled*, small, *short* (about half a line), *ovate-lanceolate*, widest at about one-third from the base, not much attenuated at point, carinate with the nerve prominent at back, margin variously recurved, occasionally very faintly indeed, thickened above; hyaline point very variable, *usually about* ⅔

† N.B.—The measurements of the length of the leaves are exclusive of the hair points.

length of leaf, sometimes exceeding the rest of the leaf, or very short and almost obsolete, terete, quite smooth or minutely denticulate, broad at base or narrow. Basal cells at angles rectangular, hyaline, in two or three rows extending a short distance up the margin, the median narrower, coloured (yellow or chlorophyllose), those next the nerve very narrowly linear, with thick, slightly sinuose walls; above shorter, elliptic, chlorophyllose, sinuose, in upper part of leaf *rectangular or quadrate*, the walls incrassate, smooth or slightly sinuose, rather pellucid, in two strata near the apex. Seta very short, hardly longer than the broad, concave perichaetial bracts, arcuate, pale yellow; calyptra small, mitriform, 3-5 lobed; capsule small, faintly striate when dry, pale brown, lid conical, obtusely apiculate; peristome teeth irregularly divided and pierced at the apex, red. Dioicous.

HAB. Siliceous rocks on mountains; not common. Fr. autumn.

There is a peculiar look about this plant by which it may generally be known in the field; this is partly due to the dense level tufts, dark grey or blackish, only the few uppermost leaves on each stem forming minute separate points of green; and also to the stems falling away from one another upon gathering, so that it is difficult to preserve good tufts; but the feature by which it is most readily known is the spiral twisting of the leaves when dry, giving the stems exactly the appearance of miniature ropes. In *G. incurva* the leaves though twisted are not appressed, and hence do not present this appearance; in *G. torquata* -which in colour and texture is very different -the leaves are much less closely appressed, often more or less twisted upon themselves, and more rarely, therefore, present the strict, close rope-like appearance of the present plant. The hair-points in this plant are almost always longer than in that. The shorter and broader leaves will usually distinguish it from *G. trichophylla* and the smoothish hair points from *G. Muehlenbeckii*.

The more luxuriant the stem and leaves the more pronounced is the cable-like twisting; in slender and dwarfed forms it is sometimes scarcely perceptible. In these cases there are also often to be found exceedingly slender filiform stems with minute leaves, intermixed with the normal stems.

In the old leaves, as is often the case with members of this genus, the upper cells are blackish, very obscure, and hardly distinguishable.

7. Grimmia torquata Hornsch. (Tab. XVIII. D.).

In *large, swollen cushions*, 1-3 inches high, *soft;* stems slender, branched, coherent, bright or yellowish green above, *reddish brown below*. Leaves erecto-patent, when dry *incurved, twisted and spirally contorted, very small and narrow, oblong-lanceolate*, carinate, the lower hairless, the upper with a *very short, flat hyaline point;* margin plane or lightly reflexed, nerve thin, areolation resembling the last, but more incrassate and sinuose, pellucid. Seta longer than in the last, arcuate when young, erect and flexuose when ripe, pale yellow; capsule oval, when mature oblong, pale brown, irregularly striate longitudinally when dry, calyptra small, lid with a slender straight beak; peristome teeth yellow, short, irregularly bifid. Dioicous.

HAB. Shaded alpine rocks ; not common. Barren in Britain.

The fruit of this plant was found for the first time in the Rocky Mountains, by Leiberg, in 1888, and again in Norway by Ryan in 1892 ; it is elsewhere unknown. The barren plants frequently produce filamentous or globose clusters of cells on the leaves, and these gemmae serve to reproduce the plant, as in so many mosses. When once known it is a species easily recognised ; in aspect it resembles *Anoectangium compactum* rather than any of the species of its own genus, and the extremely short hyaline point is hardly visible except under the microscope. The leaves are more lax and less closely appressed when dry than in the last, so that the twisting of the leaves is looser, though sometimes quite as rope-like and pronounced, and the upper leaves are usually less spirally arranged and more irregularly incurved. The whole texture, too, is softer, and the stems though easily separable do not fall apart of their own accord when gathered. The colour, moreover, is as a rule quite different. The leaves are about equal in length, but rather narrower.

8. Grimmia pulvinata Smith (*Bryum pulvinatum* L.) (Tab. XVIII. E.).

In small, rounded, neat, dense cushions, $\frac{1}{2}$–1 inch high, hoary with the hair-points of the leaves. Upper leaves *broadly oblong-lanceolate, wide at apex*, about $\frac{3}{4}$ line long, spreading, when dry *erect and appressed*, ending in a long flexuose denticulate hair, the lower narrower ; margin slightly recurved below, *thickened above ;* nerve distinct ; cells all short, at base lax and shortly rectangular, *hardly any as much as twice as long as wide, almost uniform throughout the breadth of the leaf*, thin-walled ; gradually becoming shorter and smaller above and incrassate, quadrate-hexagonal and rounded, with the walls sinuosely incrassate. Seta cygneous, reddish, capsule hidden among the comal leaves—after maturity the seta, when dry, becomes erect—calyptra *mitriform* (rarely sub-cucullate) ; capsule oval, when dry reddish brown, wide-mouthed, widely but distinctly 8-striate ; lid *shortly rostellate*, straight or oblique ; peristome teeth dull red, spreading when dry, densely barred, unequally divided above and perforated. Annulus broad. Autoicous.

Var. β. *obtusa* Huebn. (*Dryptodon obtusus* Brid.). Capsule *smaller*, on a shorter seta, shorter, the lid *obtuse, shortly and bluntly pointed.*

HAB. Walls and rocks in lowland districts. Abundant. The var. β rare. Fr. spring.

This is the commonest species of the genus, and may usually be found on almost any stone wall loaded with capsules in one stage or another of development. It is very rarely found at high altitudes. The neat, round, hoary cushions, the cygneous fruitstalks and the comparatively broad leaves will easily distinguish it from all species but the next, to which indeed, as far as concerns the fruit, the var. *obtusa* is in some degree an approach. The broader leaves with uniformly short basal areolation will separate it from that without difficulty under the microscope.

9. Grimmia orbicularis Bruch (Tab. XVIII. F.).

Resembling the last species. Cushions larger and less defined, stems more readily separating when gathered. Leaves *narrower*, oblong-lanceolate, rounded at apex; margin *not thickened;* basal cells *near the nerve linear-rectangular, 6–8 times as long as broad*, yellowish, the others as in the last, *at angles shorter*, wider, hyaline in two or three marginal rows; the upper cells resembling *G. pulvinata.* Seta pale; calyptra *cucullate;* capsule smaller, oval-globose, bright reddish brown, when dry very faintly striate, slightly contracted at the mouth; lid *short, obtuse, mamillate.* Annulus narrow. Peristome pale red, more distantly and distinctly barred.

Hab. Calcareous walls; not common. Fr. spring.

Of a rather duller colour than the last species, but with rather more brightly coloured capsules, and differing markedly in the characters italicised above. Without microscopic examination the var. *obtusa* of that species might easily be taken for it, and the two occasionally grow together. The basal cells will, however, aid in separating them under the microscope. I have found the marginal rows of upper cells bi-stratose in plants from Herefordshire, but this is extremely rare.

10. Grimmia trichophylla Grev. (*G. fuliginea* Stirt. in Ann. Scot. Nat. Hist. xvii, 171; *G. polita* Stirt., op. cit., xvi, 172; *G. rubescens* Stirt. in Scot. Bot. Rev. i, 90; *G. undulata* Stirt. in Scot. Bot. Rev. i, 91) (Tab. XVIII. G.).

In loose wide patches, grey or yellowish green, sometimes blackish, ½-1 inch high. Leaves *narrow and elongated, linear-lanceolate to broadly lanceolate, tapering to a long point*, erecto-patent, when dry appressed or slightly twisted, the lower small, with short points, the upper larger, longer (¾–1¼ lines), ending in *longer smooth or faintly denticulate hair-points*, usually about half the length of the leaf, sometimes longer. Nerve strong, elevated at the back of the leaf, semi-terete; one or both margins recurved below. Cells at base variable, the marginal usually shorter and wider, more or less hyaline, rectangular, the other basal cells longer, narrowly rectangular or linear, but never very narrow nor elongated; *faintly but not strongly sinuose, nor very incrassate;* all quickly becoming shorter and smaller upwards, sinuosely quadrate in two or more layers towards margin, in upper part of leaf *very small, incrassate, quadrate or slightly irregular, sinuose*, often obscure and opaque. Dioicous. Perichaetial bracts sheathing; calyptra mitriform or sub-cucullate; seta cygneous, afterwards erect and flexuose, pale, capsule oval or oblong, not wide-mouthed, pale yellow, when old brown, *more or less strongly plicate;* annulus distinct, separating in fragments; lid very

variable, from acutely conical to longly rostrate, obtuse or acute; peristome teeth red, erecto-patent when dry, 2–3-cleft, papillose.

HAB. Rocks and walls, not uncommon. Fr. less frequent, summer.

A variable species, both in habit and structural detail; rarely without some tinge of yellow, which, with the laxer, wider growth, and the narrower leaves and paler capsules easily distinguishes it from the last two species. The smooth hair-point separates it from *G. decipiens* and *G. Muehlenbeckii*; *G. Stirtoni* and *G. subsquarrosa* differ in the shorter, wider, basal cells; *G. robusta* is very near it, but the inflorescence is autoicous, and the cells are usually decidedly more sinuose, the basal ones especially so, and shorter. Tall robust forms of the present species approach *G. elatior*; but the leaves in that are longer and larger, with the basal cells very narrow, sinuose, and incrassate, and the upper larger and more distinct. Except in the twisting of the leaves when dry *G. funalis* is very like it, but the leaves of that species are almost always shorter, and in proportion to their length broader.

On the Continent it varies even more than with us, and two or three species have been described from what are, in the opinion of recent authors, only varietal forms.

Grimmia polita Stirt. is the propaguliferous form of *G. trichophylla*, which form, by the way, is not—as Limpricht states—the same thing as *G. subsquarrosa*.

*** Grimmia Muehlenbeckii** Schp. (Tab. XVIII. I.).

Very near *G. trichophylla*, and by some authors considered a variety only, differing as follows:—Rather darker in colour than the usual form of that plant, leaves broader, more strongly keeled with the nerve more prominent at back, *hair-point strongly denticulate or spinulose*; the margins less recurved; the capsule *smaller, shorter, smooth or very indistinctly striate* when dry; annulus less distinct, persistent. These characters are, however, subject to much variation, whether in *G. trichophylla or G. Muehlenbeckii*, and it appears to be a rule that in *G. trichophylla* the shorter the capsule the less plicate it becomes, while the greater or less denticulation of the hair-point is equally unimportant, typical specimens of *G. Muehlenbeckii* as regards the fruit sometimes having the hairs only faintly denticulate. It usually grows in more compact tufts, not in loose wide patches as does *G. trichophylla*, and is more at home at high altitudes, whereas the latter prefers subalpine situations and more exposed rocks.

HAB. Siliceous rocks, usually on mountains. Very rare. Ballater, Kynance Cove. Fr. summer.

*** Grimmia Stirtoni** Schp. (Tab. XVIII. H.).

In small *dense* blackish cushions, about $\frac{1}{2}$ inch high. Leaves *crowded, short*, ovate-lanceolate, *hardly narrowed at the insertion as in G. trichophylla and G. Muehlenbeckii, erecto-patent*, margin

slightly recurved below, or almost plane, thickened above, upper leaves ending in a *short, nearly entire hair ;* areolation resembling that of the last species, wide, not sinuose, and shortly rectangular at base, above small, rounded-quadrate, more or less incrassate and sinuose, in regular longitudinal rows. Gemmae are usually found in some quantity among the comal leaves, produced on rudimentary leaf structures, and sub-spherical or clavate in form. Dioicous. Fruit unknown.

Hab. Basaltic and siliceous rocks ; rare.

After much hesitation, I have placed this as a sub-species of *G. trichophylla*. It cannot be looked upon as simply a gemmiparous form of that species, since *G. trichophylla* occurs bearing abundant gemmae among the upper leaves, but retaining all the typical leaf characters (length of leaf, elongated basal areolation, etc.). But on the other hand in N. Wales, where *G. Stirtoni* occurs in several localities and in some abundance, I have gathered both plants growing together, with certain intermediate forms throwing considerable doubt on the specific value of *G. Stirtoni ;* not only is the habit in some plants intermediate, but the leaves on some stems show a perplexing variety of areolation, tending to intergrade between the short, smooth cells of *G. Stirtoni* and the elongate, narrow areolation of *G. trichophylla*. It must be admitted also that there is a generally dwarfed appearance about *G. Stirtoni* that gives rise to some suspicion, which the continued absence of fruit tends to confirm. It is probably, in fact, little more than a starved form of *G. subsquarrosa*.

* **Grimmia subsquarrosa** Wils. (*G. inaequalis* Stirt. in Ann. Scot. Nat. Hist. xvii, 172) (Tab. XVIII. J.).

In small lax tufts, one inch high, dull green above, blackish below ; resembling *G. trichophylla ;* leaves crowded, gradually longer upwards, *forming a slight comal tuft at the apex of the slightly curved branches*, the lower patent, *the upper squarrose*, when dry erect and appressed ; broader than in that species, and *shorter* ($\frac{1}{2}$–$\frac{3}{4}$ lines), margin recurved ; lower muticous, upper with a shorter, smooth or slightly roughened hair, about $\frac{1}{3}$ length of the leaf ; basal cells *short, wide*, rectangular, somewhat hyaline, rather thin-walled, with the walls *smooth, not sinuose*, about $1\frac{1}{2}$ times as long as wide, a few near the nerve occasionally longer and narrower ; in the upper part of the leaf minute, sub-quadrate or irregular, obscure, often incrassate. I have seen no description of the fruit ; the capsules resemble those *G. trichophylla* but are usually smaller and short. Dioicous.

Var. *β. edinensis* Braithw. (*G. edinensis* Ferg.). *Very short*, black, in dense cushions ; *leaves shorter*, less concave-carinate, less squarrose.

Hab. Siliceous rocks, rather rare. Usually in shade or near water. The var. *β*, Arthur's Seat (*Fergusson*) ; Callerfountain Hill, Perthshire (*Meldrum*). Fr. very rare.

This plant has, so far as I am aware, been found outside Great Britain only in a single station in France. The fruit has only been detected in one or two localities. The minute globose gemmae which are stated by Braithwaite to occur on the surface of the leaves are rare, and occur equally in forms of *G. trichophylla*. By the basal areolation and by the decidedly squarrose-recurved comal leaves it may without much difficulty be recognised. Plants from numerous localities show much variation, and clear intergrading with *G. trichophylla*, and it is certainly not deserving of a higher rank than that of a subspecies. There is every reason indeed to think it merely a hygromorphous form of *G. trichophylla*. I find it very difficult to separate the var. *edinensis* from *G. Stirtoni*, which also grows on Arthur's Seat.

11. Grimmia decipiens Lindb. (*Trichostomum decipiens* Schultz; *G. Schultzii* Wils., Schp. Syn; *G. subaquila* Stirt. in Ann. Scot. Nat. Hist. xviii, 243) (Tab. XVIII. K.).

Robust, in lax tufts or patches, 1–1½ inches high, stems easily falling apart; yellowish or grey above, darker below, hoary with the hair-points of the leaves. Leaves crowded, spreading, *large*, from an *oval-oblong broad base gradually narrowed to a lanceolate point*, 1–1½ lines long, concave, carinate above, margin recurved, nerve broad, strong; hair-point *long*, sometimes almost equalling the rest of the leaf, *strongly spinosely denticulate*, decurrent at the margins of the leaf-apex. Cells at basal margins short, rectangular, hyaline, in 4–6 rows, forming marginal bands distinct throughout the leaf-base, the median *narrow-linear and elongate, slightly sinuose*, thin, yellowish above becoming shorter and more sinuose, *very sinuose and rectangular in the rest of the leaf*, near summit sub-quadrate, regular, rather incrassate, in two strata, rather large. Capsule oval-oblong, brown, *strongly striate*, longer and larger than in *G. trichophylla*; lid rostrate; calyptra mitriform, lobed. Peristome teeth lanceolate, deeply divided into two, rarely three, filiform branches. *Autoicous*; male flowers axillary.

HAB. Siliceous rocks, at low elevations; not common. Fr. summer.

Easily known by its robust habit and rough, long hairs, the autoicous inflorescence, the sinuose areolation, etc. The last character is somewhat variable however, as is also the amount of roughness of the hair-points, and forms occur linking it with the sub-species *G. robusta*. *G. elatior* has still longer leaves with smoother points, and is dioicous. The fruit in *G. decipiens* is generally present and abundant.

*** Grimmia robusta** Ferg. (*G. decipiens* var. *robusta* Braithw., Brit. M. Fl.) (Tab. XIX. A.).

Closely resembling *G. decipiens*, but differing in the darker tufts, the stems less branched; the leaves *smaller*, with the hair-point *shorter, smooth or nearly so*, the cells *short, rectangular and sinuose almost to base*, only a few rows near the nerve being narrow and elongated. Fruit not seen.

Hab. Rocks. Rare.

Braithwaite is no doubt right in uniting this with *G. decipiens*, though where sub-species are admitted it is probably worthy of the higher rank. It also comes very near *G. trichophylla* in some of the forms of that moss, but the cells are more distinctly sinuose, the leaves closer and wider, and the colour different from what is usual in that species.

12. Grimmia elatior B. & S. (Tab. XIX. B.).

Tall and robust, 1–3 inches high, in lax tufts, the stems easily separating, naked and decumbent at base, dichotomous; grey or yellowish green above, blackish below. Leaves erecto-patent, appressed when dry and straight or turned to one side, *very long, from a wide oblong base gradually lanceolate*, carinate-concave, 1–1¾ lines long, one margin strongly revolute, the other less so or plane, sometimes obscurely toothed near apex, hair-point *short*, about ¼–⅛ length of leaf, smooth or slightly denticulate, narrow at its base, nerve strong, prominent at back. Basal cells yellowish, *narrow-linear, elongate, strongly sinuose and incrassate*, a few rows at margin short, rectangular, thin-walled; above the cells rapidly shorten, becoming very sinuosely rectangular, then *quadrate and irregular, small, incrassate, all sinuose*, opaque, in two or three strata near apex, irregularly papillose. *Dioicous*. Seta short, curved, pale; calyptra mitriform, capsule rather large, pale brown, oval-oblong, sulcate when dry: lid rostellate; teeth of peristome bright red, irregularly divided, closely articulated.

Hab. Siliceous rocks in mountainous regions; very rare. Clova (*Fergusson*). Barren in Britain. Fr. spring.

One of the most robust of our species; *G. decipiens* differs in the rough hairs, shorter leaves and autoicous inflorescence; *G. robusta* in the shorter leaves, much shorter, less incrassate and narrower basal areolation; *G. trichophylla* sometimes approaches it, but it is never quite so large in its parts, and the basal cells are less incrassate, less sinuose and wider, and the nerve weaker; the fruit is quite distinct.

13. Grimmia Hartmani Schp. (Tab. XIX. C.).

In wide patches, yellowish-green above, brown or blackish below; stems *tall*, 1–2 inches high, *ascending, procumbent*, naked at base, rigid, somewhat dichotomous, branches ascending. Leaves patent or recurved, frequently, *especially the upper ones, falcato-secund*, when dry slightly contorted, long (1–1½ lines), *pellucid*, broadly lanceolate from a wide base, gradually narrowed to an acute apex, the tip denticulate, *pellucid or hyaline in a very short hair-point*: one or other margin recurved; cells of mid-base narrowly rectangular, incrassate, slightly sinuose, about 3–6 times

as long as broad, becoming shorter and more sinuose upwards, a few rows at margin shorter, wider, hyaline with thinner walls ; in upper part of leaf small, rounded, or sinuosely quadrate and irregular ; nerve pale, prominent behind, terete or angled at back, not winged ; *terminal clusters of brown globular gemmae* usually occur conspicuously on small, thin, deformed leaves at the apex of the stems. Dioicous ; capsule oblong, smooth ; calyptra mitriform, lid rostellate, peristome teeth almost entire.

HAB. Siliceous rocks, not common. On trees, Aber. Fruit not found in Britain.

This curious and interesting moss resembles some species of Rhacomitrium in habit more closely than those of its own genus, but may be recognised by the spreading falcato-secund upper leaves, with very small hair-points, and by the terminal balls of brown gemmae, which are usually present and conspicuous ; the areolation is, of course, quite different. The stems are more rigid, and the whole plant less hoary and greener than most of the allied species of Grimmia. The fruit has only been found in two or three localities in Central and Southern Europe.

*** Grimmia retracta** Stirton, Scottish Naturalist 1886, p. 234. (Tab. XIX. D.).

In dense tufts, stems more erect than in *G. Hartmani ;* occasionally yellowish but much more frequently dark green above, black below. Leaves *not secund, recurved-squarrose all round the stem*, when dry erect and somewhat appressed, scarcely at all contorted ; *shorter and usually less tapering*, entire above, shortly hair-pointed or muticous, at times obtuse ; *gemmae absent ;* cells at base *shorter and wider*, rectangular and hyaline, or narrower and pellucid, but not or very rarely and slightly incrassate and sinuose. Fruit unknown.

HAB. On boulders by lakes and streams, frequently embedded in sand. Not unfrequent in the west and north ; England ; Wales ; Scotland.

This plant is intermediate in habit and other characters between *G. Hartmani* and *G. subsquarrosa*, and has been until recently confused by many bryologists with the latter.

In habit, leaf direction, and some other characters, notably the apparently constant absence of apical gemmae, *G. retracta* differs markedly from *G. Hartmani*. Certain specimens however approach that species very closely in appearance and in length of leaf, and as the leaf-structure hardly differs in any way but in the somewhat shorter, not sinuose basal cells, I have thought it best to treat it as a sub-species of that plant. The basal areolation varies considerably, and not unfrequently the cells in some leaves remain short, wide and rectangular to the base just as in *G. subsquarrosa*. Stirton has described a var. *submutica*, of a darker colour, and with the leaves frequently wanting a hair-point. I find these characters, however, eminently variable, and I scarcely think the variety a definable one.

G. retracta appears to be confined to the banks of lakes and rivers, and is quite abundant in some parts of the R. Wye, and beside some of the English and Scotch lakes.

A very remarkable form occurs on rocks beside the River Wye between Builth and Erwood; growing in large dense tufts with the normal form it is of a much paler green, the leaves lingulate and widely obtuse, not at all acute, without any trace of hair-point, and with the nerve ceasing at some distance below the apex. The cells are larger, with thinner walls, very distinct, and chorophyllose.

14. Grimmia patens B. & S. (*Bryum patens* Dicks. *Rhacomitrium patens* Huebn., Schp. Syn.) (Tab. XIX. E.).

In large dark loose tufts, bright or yellowish green above, *black* below; stems decumbent, naked at base, easily separating, repeatedly dichotomous, 1–3 inches long, branches curved, especially when dry. Leaves patent or slightly secund, when dry erect and appressed, from a broad, oval-oblong base, elongate-lanceolate (1–1¼ lines), tapering to an *entire or slightly toothed point*, not hyaline; margin recurved below, slightly thickened above; nerve very prominent at back, *strongly two-winged in the upper half of the leaf*. Basal cells yellow, narrow-linear next the nerve, with the walls smooth or slightly sinuose, becoming shorter, wider and more sinuose outwards, a few rows at margin shorter, with thinner walls, not sinuose, pellucid but not hyaline; all becoming rapidly shorter above, sinuosely rectangular, then *minute, rounded or transversely elliptical and compressed, very dense*, in regular longitudinal rows, 2–3 stratose, all more or less incrassate. Seta rather long, arcuate, yellow; at maturity erect and flexuose; calyptra mitriform, lobed; capsule oval-oblong, *rather large*, pale yellowish brown, plicate when dry; lid shortly subulate, straight, usually falling with the calyptra; peristome teeth long, divided into two filiform branches. Dioicous.

Hab. Siliceous rocks on mountains. Not common. Fr. spring.

A very distinct species, resembling in habit slender, dark forms of *Rhacomitrium protensum*, but of a much softer texture when moist, though somewhat rigid when dry; the curious double wing at the back of the nerve is quite perceptible with the lens, especially in the dry state, and will serve to distinguish the species from all other plants it may resemble. The ripe fruit is very persistent, and soon has the appearance of being lateral, from the growth of the innovations.

A few cells at the apex of the leaves are occasionally diaphanous, but I have rarely seen anything approaching a hyaline point, which Boulay describes as sometimes occurring; the leaves vary much in the relative acuteness of their points.

* * Seta erect (except in *G. arenaria*).

15. Grimmia Doniana Sm. (Tab. XIX. F.).

In small *dense rounded neat cushions*, about ½ inch in height, greyish green above or almost black. Leaves spreading, appressed when dry, the uppermost longer (1 line), oblong-

lanceolate, terminating in a *slightly toothed hair often nearly as long as the leaf*, but very variable in length; the lower small, muticous; margin *plane*, slightly thickened above; nerve narrow, obscure at apex. Cells at base *thin-walled, narrowly rectangular, 4–6 times as long as broad*, the marginal at times well marked, hyaline in 3–6 rows, often hardly distinct; becoming shorter, chlorophyllose, incrassate and sinuose above, in upper part 2–stratose, sinuosely rectangular or sub-quadrate. Capsule on a *short, erect* or *very* slightly curved seta, hardly elevated above the upper hair-points, pale brown, oval-oblong, small, erect, *smooth*; lid *conical, obtuse*; annulus more or less developed, often detaching itself in fragments or single cells; calyptra mitriform, or at times cucullate; peristome teeth red, scarcely divided, often perforate. Autoicous.

HAB. Siliceous rocks in mountain districts; not unfrequent, and in some places abundant. Fr. spring to late summer.

Usually easily recognised by its neat compact black cushions, with abundant small smooth capsules on straight setae. It is perhaps most like *G. montana* and *G. ovata*, the former differing in its shorter basal cells; the latter in the shorter hair-points, the more sinuose basal areolation, the slightly revolute margin, etc.

The cucullate calyptra that sometimes occurs cannot be considered a character of importance, as it is not constant in the same tuft.

The var. *sudetica* Wils. (with longer hair-points and capsule scarcely emergent), not a very marked form at best, is perhaps better dropped, as its characters are only comparative, and are eminently variable throughout the whole species, and no clear line can be drawn between type and variety.

*** Grimmia arenaria** Hampe (*G. curvula* Bruch, Schp. Syn) (Tab. XIX. G.).

Closely allied to *G. Doniana*. Tufts greyer, *very hoary* with the long hair-points of the leaves, which are often *depressed and all pointing in the same direction*, giving a characteristic appearance to the tufts; leaves usually somewhat narrower, the basal cells often shorter, but these characters are not constant; hair-point *often as long as the leaf*, smooth or roughish. Seta short, *curved downwards*, so that the capsule is hidden among the leaves, or protrudes laterally from among the perichaetial bracts. Capsule *considerably smaller*, lid very small, obtusely conical or convex; annulus often persistent. Peristome teeth usually a little more delicate, at apex often split into two or three coherent branches, more strongly perforate.

HAB. Siliceous rocks and walls in mountainous districts; very rare. First found by Prof. Barker in 1898, between Dolgelley and Barmouth, and afterwards discovered in two or three other localities in Merionethshire and Denbighshire. Fruit late summer.

The habit, curved seta, and minute capsule give this moss a most distinct appearance, but in spite of this I am convinced of its close relationship to *G. Doniana*. It is difficult indeed to point out any structural character so clearly separating the two as to constitute an undoubted specific difference. The curved seta is the strongest point, but the seta of *G. Doniana* not unfrequently shows a tendency in the same direction. The capsules are very inconspicuous, not only on account of their small size, but owing also to their position and the very long hair-points among which they lie hidden. In structure, however, they are almost exactly identical with dwarfed capsules of *G. Doniana*. I do not find the characters attributed to the peristome and annulus of any permanent or practical value, and the same remark must apply to the leaf characters.

Forms of *G. Doniana* with long hair-points resemble this moss in the hoariness of the tufts, but owing to the erect stems with leaves pointing in all directions, they lack its characteristic smooth, mouse-like appearance. The minute pale capsules, smooth or practically so, will separate it from the other species of Grimmia with curved setae.

16. Grimmia ovata Schwaeg. (*G. ovalis* Lindb., Braithw. Br. M. Fl; *G. hemipolia* Stirt. in Ann. Scot. Nat. Hist. xi, 109) (Tab. XIX. H.).

In small, not very compact cushions, ½–1 inch high, olive-green or black, sparingly hoary. Leaves spreading, *closely appressed when dry*, the lower small, muticous, the upper longer (one line), lanceolate-acute from an oblong or slightly obovate base, ending in a rather long almost smooth hair, *about ⅓ length of leaf in the uppermost leaves;* one margin slightly recurved, the other plane, thickened above; nerve rather thin and faint, obscure in the upper part; basal cells near the nerve narrow-linear, 4–8 times as long as broad, rather incrassate and faintly sinuose, becoming shorter near the sides of the leaf, at margin about three rows much shorter, thin-walled, rectangular, hyaline; all quickly becoming short, sinuose-rectangular, in the upper half rounded-quadrate with sinuose walls, very obscure, in two strata. *Autoicous*. Capsule exserted on a pale seta, oval-oblong, rather narrow, *pale brown*, smooth; calyptra mitriform, sometimes sub-cucullate; lid *shortly rostellate*, sub-obtuse, straight or oblique; peristome teeth divided to the middle into two or three branches, more or less united.

Hab. Siliceous rocks on mountains, not common. Fr. usually in winter.

The closely appressed leaves give the stems a neater appearance when dry than in most of the species, and the hair-points, though rather long in a few of the comal leaves, are not very numerous, so that the plant is less hoary than in most of its allies; it is more robust and laxer in habit than *G. Doniana*, which it most resembles, with longer capsules on longer fruit-stalks, more solid and more sinuose basal areolation, etc.

The var. *cylindrica* Huebn., which I have gathered in Perthshire, is a fairly well characterised form, with larger, oblong-cylindrical capsules, and often longer and more sharply beaked lids. Nees and Hornschuch described it as a species in common with two or three other unimportant forms.

17. Grimmia commutata Huebn. (*G. ovata* W. & M., Braithw. Br. M. Fl.) (Tab. XIX. I.).

Taller and more robust than the last, in larger less compact cushions, 1–1½ inches high, dull green or blackish. Leaves less crowded, *less regularly appressed when dry, larger and longer*, 1–1¼ lines long, more uniform throughout the stem, very concave, from a short, very broad sheathing base, lanceolate, ending in a *rather long*, stout, faintly denticulate hair; nerve distinct, rather narrow, obscure above; margins plane, erect or slightly incurved, somewhat thickened above, basal cells resembling the last, but *with a much wider band of marginal hyaline cells, in 5–10 rows;* very quickly becoming sinuose-quadrate, above rounded-quadrate, incrassate, very obscure, bi-stratose. *Dioicous.* Capsule on a pale seta, exserted, oval or elliptic, *dark reddish brown*, smooth, contracted at mouth; calyptra cucullate, large; lid with a longer oblique beak; peristome teeth divided to the middle and perforate.

HAB. Siliceous rocks. Rare. Fr. spring.

This is a coarser, more robust plant than the last, more hoary with the hair-points, and especially distinct in the inflorescence. The character drawn from the calyptra is rather misleading, since, according to Boulay, the base is sometimes 3-4 lobed, while in *G. ovata* it is not uncommon to find it sub-cucullate, deeply cleft on one side and oblique, and only very faintly lobed otherwise. *G. montana* and *G. alpestris* differ in the shorter basal cells and less concave leaves, as well as in the smaller and more slender habit.

A form occurs with the basal cell-walls scarcely sinuose, and hair-points rougher.

18. Grimmia montana B. & S. (Tab. XX. A.).

In low compact cushions, scarcely an inch high, dark green, or hoary with the hair-points of the leaves; leaves erecto-patent, erect when dry, resembling those of *G. ovata* in shape, lanceolate from a broader base, short (¾ line long), margins plane; *hair-point fully as long as the leaf in the uppermost leaves of the stem, denticulate*, wide at base and decurrent, nerve distinct; *basal cells almost uniform*, resembling those of *G. pulvinata, rectangular, hyaline, short* (1½–2 times as long as broad), with rather thin but firm, not sinuose, walls, those nearest the nerve a little narrower and longer; above quickly becoming small, chlorophyllose, quadrate, faintly sinuose, in upper half small, roundish-quadrate, obscure, incrassate. Dioicous; *seta short*, pale; calyptra cucullate, large; capsule shortly oval or oval-oblong, smooth, reddish brown; *lid rostrate, ⅓ length of capsule.* Peristome teeth pale, narrow, irregularly cleft.

HAB. Siliceous and calcareous rocks at low elevations. Rare. In fruit, Fingle Bridge, Devon. Fr. spring.

The small hoary tufts resemble *G. pulvinata*, but the fruit when present is quite different. The short, wide, basal areolation will readily distinguish it from all the allied species except the next, which it very closely resembles; the distinguishing characters are pointed out under that plant.

19. Grimmia alpestris Schleich. (*G. Ungeri* Juratz., Schp. Syn. (Tab. XX. B.).

In small fragile tufts, with a bluish or glaucous tinge. Very near *G. montana*, differing in the leaves, slightly more erect and straight when moist, rather shorter and broader at the points, the margins more inflexed, and more strongly thickened, the hair-point *rather shorter and smoother;* perichaetial bracts larger, broader, half-sheathing. Capsule on a *rather longer seta*, smaller, rather narrower, oblong-cylindric; *lid conical, short, obtusely pointed.* Dioicous or rarely autoicous.

Hab. Siliceous rocks in alpine districts. Very rare. Near Ballater. Clova. Fr. spring.

G. alpestris, besides being closely allied to *G. montana*, is liable to be confused with lax forms of *G. Doniana*, which however has longer and narrower basal cells and a usually mitriform calyptra.

G. subsulcata Limpr., a very closely allied species, has a faint fold or furrow on each side of the nerve in the upper part of the leaf; the capsule also has a few large stomata, which are lacking in *G. alpestris*, with a few minor differences. Many of the records of *G. alpestris* have proved to refer to this plant, but all the British specimens I have seen belong to *G. alpestris*.

20. Grimmia leucophaea Grev. (*G. campestris* Burchell, Braithw. Br. M. Fl.) (Tab. XX. C.).

In loose wide low patches, easily breaking up, dull green, hoary above. Leaves crowded, gradually larger towards the apex of the branches, closely and regularly appressed when dry, concave, *short*, ($\frac{1}{2}$–$\frac{3}{4}$ line), *very broad, triangular-oval or oval-oblong, broad at the apex*, terminating in a *very long, finely denticulate, flattened hair*, which is very wide at the base and decurrent, *often longer than the leaf;* margin *plane, not thickened;* nerve thin, flattened. Upper cells roundish-quadrate, very chlorophyllose, the basal *rectangular*, more diaphanous, a few rows next the nerve slightly elongate and hyaline, the rest shorter (often broader than long,) more quadrate; all slightly incrassate, and *non-sinuose*. Capsule hardly exserted, erect, oblong, rather large, smooth, thick-walled; calyptra mitriform, lobed; lid rostellate. Dioicous.

Hab. Dry siliceous rocks in warm situations. Not common. Fr. spring.

A very distinct plant, the broad, short leaves having no resemblance to those of any of the species of this Section, except *G. homodictyon*, *G. pulvinata* and *G. orbicularis*, both of which latter plants differ in habit, in the fruit and in the recurved leaf margins. *G. homodictyon* differs in the more tapering leaves with recurved margins. The broad, white hair-points are very conspicuous.

It is a southern and lowland rather than an alpine plant.

21. Grimmia homodictyon Dixon, Rev. Bry. 1901, p. 12. (Tab. XX. D.).

Tufts grey, low, hoary with the hair-points of the upper leaves, stems readily falling apart, ½ inch, slightly branched, erect, *straight, rather rigid*. Leaves *crowded*, erecto-patent when moist, *erect, appressed and straight when dry*, ovate-lanceolate, gradually tapering from a rather wide ovate base to a *somewhat broad point*, carinate-concave; upper leaves with a rather long *strongly spinulose broad hair*, resembling that of the last species. One or both margins *recurved;* margin thickened above. Nerve *distinct*, prominent at back. Cells *nearly uniform throughout the leaf;* at basal angles sometimes a small group of about half-a-dozen small, short, hyaline cells, but frequently absent, marginal cells in two or three rows at base and upwards short, small, quadrate or transversely quadrate; almost all cells of base *short*, opaque, 2–3 times as long as broad, only a very few at extreme base near the nerve elongated, 4–8 times as long as broad; above quickly becoming shorter, throughout the greater part of the leaf subquadrate, distinct; all sinuose and incrassate, except at extreme base. Flowers and fruit unknown.

HAB. On a detached block of limestone, Inchnadamph, Sutherland, 1899 (*Nicholson, Salmon and Dixon*).

G. homodictyon resembles *G. leucophaea*, but differs at once in the recurved margin, more tapering leaves, well defined nerve, etc. It also comes near some forms of *G. apocarpa*, but differs in the loose grey tufts, and the much denser, closely imbricated leaves.

It appears to be closely allied to *G. calyptrata* Hook., a Western United States species, but presents certain well defined differences; it also bears much resemblance to another N. American species, *G. pennsylvanica* Schwaeg. In the absence of fruit, however, it is imposible to be certain of its affinities, and it is quite possible that it may ultimately have to be placed under Schistidium.

22. Grimmia elongata Kaulf. (Tab. XX. E.).

In tall lax tufts, 1 2 inches high, with long slender stems, decumbent at base and often denuded, frequently half buried in sand, of a dull green or *reddish-brown colour*. Leaves crowded, appressed and slightly twisted when dry, *small*, ½–¾ line long,

narrowly oblong or linear, carinate-concave, one margin slightly recurved, thickened above; nerve narrow but distinct; lower leaves muticous, only the upper with a *very short, narrow hyaline point*, or even a few cells only diaphanous. Cells of mid-base *elongate-rectangular or linear*, with smooth walls, a few rows towards margin sinuose, yellow, slightly incrassate, about two rows at margin shorter, broader, hyaline, forming a border extending a considerable distance up the leaf; above, the cells become chlorophyllose, *very sinuose*, rectangular, slightly shorter towards apex, but *always longer than broad*, elliptic-rectangular. Seta short, capsule exserted, small, oval, smooth, not contracted at the mouth; lid conical, obtuse; calyptra cucullate, lobed at the base; peristome teeth broad, almost entire. Dioicous.

HAB. Damp crevices of alpine rocks. Very rare and sterile. Clova (*Fergusson*); Ben Lawers (*McAndrew*); Cumberland mountains (*Binstead*).

The British form is stunted, in dense tufts less than an inch high. The very short hair-points and the reddish brown colour give the plant a very different aspect from most of the species of the genus; and the form and structure of the leaves easily determine it. Perhaps *G. torquata* comes nearest to it in the leaves, but the basal areolation differs, and the habit is quite distinct.

23. Grimmia atrata Mielich. (Tab. XX. F.).

Robust, 1-2½ inches high, densely tufted, dark green above, *black* below; stems erect, interwoven with radicles. Leaves solid, about 1 line long, variously spreading and curved, *twisted when dry, lanceolate, gradually narrowing from base to apex, obtusely pointed; without hyaline points;* nerve *strong*, broad, rather prominent at back; margin very slightly and irregularly recurved, thickened from near the base upwards; cells at angles and for a short distance up the margins lax, quadrate, hyaline, in mid-base variable, rather short, slightly sinuose, soon becoming sinuosely rectangular, above distinct, in upper part of leaf small, sub-quadrate, incrassate. Capsule erect or slightly oblique on a rather long seta, oval-oblong, thick-walled; *lid shortly rostellate, obtuse;* calyptra mitriform or sub-cucullate. Dioicous.

HAB. Wet alpine rocks. Very rare. Fr. autumn.

The broadly-pointed leaves, quite without hyaline points, with thickened margins, distinguish this species from *G. elongata*, and indeed from all the species hitherto described, *G. patens* differing widely in habit, in the leaves straight when dry, etc.; it differs from the next in the less obtuse, not cucullate, less solid and opaque leaves, and is more like *Rhacomitrium ellipticum*, which, however, also has straight leaves when dry, and the areolation altogether different.

24. Grimmia unicolor Hook. (Tab. XX. G.).

More slender, dull green, blackish below, 1–3 inches high, in looser tufts, less coherent than the last. Stems ascending, not radiculose. Leaves from an *oblong concave base narrowly linear or ligulate, obtuse and rounded at apex* with the margins incurved and *cucullate, not hyaline-pointed*, nerve less prominent behind, flattened, and somewhat indistinct; margin plane; basal cells thin-walled, rectangular, 2–4 times as long as broad, the marginal slightly more hyaline and distinct; very quickly becoming short, incrassate, quadrate or rounded, not sinuose, in 2 or 3 strata above and very obscure and opaque. Capsule oblong, exserted on a rather long fruitstalk, erect or sub-oblique, slightly contracted at the mouth; *lid long-beaked;* calyptra mitriform or sub-cucullate. Dioicous.

. HAB. Alpine rocks; very rare. Clova. Fr. winter.

The leaves of this plant are quite different in the form of their apex from those of any other Grimmia, and this, with the total absence of hair-point, abundantly distinguishes it. It resembles *G. patens* in some respects, but the two-winged nerve in that species is visible even with only a pocket lens, so that there need be no confusion between the two. These last three species are high alpine plants, with very rare exceptions.

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31. RHACOMITRIUM Brid.

Plants with the stems *usually elongated*, dichotomously branched, the branches *often clothed with numerous short lateral branchlets;* leaves like those of Grimmia, often hair-pointed, cells *strongly sinuose*, the *lower all elongated, narrow-linear and nodulose*, a very few at basal margin occasionally different. Seta *erect;* calyptra *mitriform*, longly subulate, often papillose, not plicate, often lacerate at the base; capsule oval, oblong or cylindrical, smooth; peristome as in Grimmia, or with the teeth divided almost to base into two straight, filiform branches. Dioicous.

Although closely allied to Grimmia and more or less connected with that genus by certain species, the present genus has a distinct character of its own, and apart from the habit and mode of growth, some of the structural characters given above are by no means unimportant; and the separation of the two genera, while to say the least permissible, is undoubtedly desirable from the point of view of greater convenience. All the species except *R. canescens* and *R. lanuginosum*, are, as in Grimmia, confined to rocks. The peculiar areolation of the leaf, especially at the base,

is at once recognised under the microscope, and identifies the genus at a glance. Many of the species from their long prostrate stems, numerous short branches, and apparently lateral fructification, bear a great outward resemblance to the Hypnoid mosses.

DERIV.—*ῥακο*-(rhako) frayed, and *μιτριον* (mitrion) a cap, from the-fringed calyptra.

1 { Leaves without hyaline points....2
  { Upper leaves with hyaline points....6

2 { Cells long, very narrow ; stem with many short branches....*4. fasciculare*
  { Cells shorter ; lateral branchlets few or none....3

3 { Capsule round-ovate, hard ; ls. bistratose above....*1. ellipticum*
  { Capsule longer ; ls. of one layer of cells....4

4 { Ls. oblong, very obtuse, nerve not reaching the wide apex...*2. aciculare*
  { Ls. narrower, more tapering 5

5 { Tall, loosely matted ; without lateral branchlets....*3. protensum*
  { Small, dense tufts ; usually with a few branchlets...*5. heterostichum var. γ*

6 { Ls. with simply toothed hyaline points....7
  { Hyaline points erose, and very rough with papillae....9

7 { Branchlets absent ; capsule small, seta short....*5*. sudeticum*
  { Plant with many lateral branchlets ; seta longer....8

8 { Upper cells of ls. short, hair (in type) long....*5. heterostichum*
  { Upper cells long and narrow....*5*. ramulosum*

9 { Ls. very papillose ; seta smooth....*7. canescens*
  { Ls. smooth-(except the hyaline points) ; seta rough ....*6. lanuginosum*

A. DRYPTODON.

Stem dichotomous with equal branches, without lateral branchlets ; leaves obtuse, without hyaline points ; peristome teeth resembling those of Grimmia.

1. Rhacomitrium ellipticum B. & S. (*Dicranum ellipticum* Turn. ; *Grimmia elliptica* Arn., Braithw. Br. M. Fl.) (Tab. XX. H.).

Stems short, ½–1½ inches high, in close, *rigid* tufts, *brown*, fragile, naked at the base Leaves patent, *small*, erect and rigid when dry, more rarely longer and somewhat twisted, solid, without hyaline points, *shortly oblong-lanceolate*, widened just above the base, thence narrowed to a stout, rather obtuse point, margin plane, or slightly recurved at the base, thickened above ; nerve broad, distinct below, becoming narrower and obscure above, brownish. Cells of the base elongate-linear, strongly nodulose, incrassate ; only a single marginal row occasionally rectangular and hyaline ; above, in middle of leaf becoming shorter and wider, about twice as long as broad, at the extreme apex still shorter,

minute, obscure, bi-stratose. Seta rather short, variable in length, thick and fleshy, rigid; capsule *small, shortly oval*, smooth, glossy, after the fall of the lid somewhat urceolate, contracted below the mouth, dark brown, *of solid texture*, with a somewhat distinct neck tapering into the seta; lid straight, subulate, almost as long as the capsule; calyptra *scabrous at apex*; peristome teeth lanceolate, 2- or 3-fid; spreading when dry.

HAB. On dripping rocks and near waterfalls, in mountains. Not common. Fr. winter.

Easily distinguished by its brown, rigid tufts and small, solid, almost globose capsules, which are sometimes on very short fruitstalks and almost concealed among the higher innovations. This, as well as the two other species of the Section Dryptodon, is distinguished by its liking for humid, almost aquatic situations. *R. protensum* is perhaps the species most nearly resembling it, but is easily recognised by its larger leaves with widely recurved margins. *Grimmia atrata* also much resembles it, but has broader leaves with still stouter nerve, and the basal areolation much shorter and less sinuose. *G. commutata* also has a superficial resemblance, but the leaves with hyaline tips will alone suffice to distinguish it.

2. Rhacomitrium aciculare Brid. (*Bryum aciculare* L.; *Grimmia acicularis* C.M., Braithw. Br. M. Fl.) (Tab. XX. I.).

In coarse tufts, *dull dark green*, often becoming blackish, 1–3 inches high; stems stout, dichotomously branched, rigid, denuded below. Leaves erecto-patent, imbricated when dry, sometimes sub-secund at apex, *large, broadly oval-oblong*, sometimes slightly plicate, *often rounded at the broad, obtuse summit*, which is entire or more or less dentate, not hyaline; nerve rather narrow at the base, becoming obscure above and vanishing at some distance below the apex; margin variously recurved. Cells in one layer except in the upper part at margin, which is slightly thickened, roundish-hexagonal or sub-quadrate near apex, below elliptical-rectangular and sinuose, gradually becoming narrow-linear and sinuose at base, a few angular cells broader, shorter, quadrate, but otherwise similar. Seta straight, erect, about ½-inch long, dark brown; capsule erect, dark brown, *elliptical to sub-cylindric*, rather narrow-mouthed, smooth, lid longly subulate, almost equalling the capsule; calyptra smooth; peristome teeth divided into 2–3 unequal branches.

HAB. Rocks in streams in subalpine districts. Common. Fr. spring.

Readily known from all the other species by its broad obtuse leaves which are usually somewhat denticulate above: a fair amount of denticulation appears to be the rule rather than the exception, and the var. *denticulatum* B. & S. would seem hardly worth preserving as a named form. In habit it is not unlike some forms of *Grimmia apocarpa* var. *rivularis*. I have gathered it at Altnaharra, Sutherland, growing on tree roots by water; and on Ben More in the same county, Mr. Nicholson and I gathered a curious lax form with very distant, squarrose-recurved leaves, probably a form due to more or less submerged conditions.

3. Rhacomitrium protensum Braun (*Grimmia aquatica* C. M., Braithw. M. Fl.) (Tab. XX. J.).

In large, loose, depressed patches, 2–8 inches long; *yellowish green*, brown below, rarely blackish; stems rigid, procumbent, much branched; often curved when dry. Leaves erecto-patent or sub-secund, appressed and straight when dry, *from a wide oblong base shortly lanceolate*, at apex rather widely obtuse, quite entire, *not hyaline-pointed;* margin widely recurved, not thickened; *nerve strong, broad*, reddish, reaching to the apex or nearly so; cells in upper part of the leaf short, sinuosely elliptical, in one layer, minutely papillose, gradually becoming longer and narrower downwards, the angular scarcely distinguishable. Seta short, about ¼-inch, appearing lateral by innovation; capsule *oblong-cylindrical*, brown, often hidden by the upper branches; calyptra *smooth;* peristome teeth divided into two narrow branches, which are free or slightly cohering.

Hab. Damp rocks. Frequent. Fr. spring.

Not unlike *Grimmia patens*, but of a paler colour, more rigid, and with quite a different nerve. The leaves while narrower and more pointed than in *R. aciculare* are more obtuse than in any of the other species; in *R. fasciculare* they are much more slender and delicate, with a far fainter nerve; *R. ellipticum* has them much smaller with the upper cells bi-stratose, and the capsule is much shorter; *R. heterostichum* var. *gracilescens* is usually much more slender, dull green or blackish, with smaller leaves narrower at the tips; but some dark-coloured, stunted forms of *R. protensum* are very hard to separate from the obtuse-leaved form (*R. obtusum* Lindb.). According to Limpricht, they may be separated by the papillose leaves of *R. protensum*, and its cells in a single layer throughout; but the papillosity is sometimes very faint, while *R. obtusum*, according to Braithwaite, may have the upper cells unistratose. The other species are known by their hair-points. It is sometimes of luxuriant growth, and I have seen the face of a large rock covered with a rich golden green carpet of this moss, the stems 6 or 8 inches long.

B. EU-RHACOMITRIUM.

Stems with fasciculate branches and often with numerous short lateral branchlets. Leaves usually hair-pointed. Peristome teeth generally divided more than half-way into two filiform branches.

4. Rhacomitrium fasciculare Brid. (*Bryum fasciculare* Schrad.; *Grimmia fascicularis* C.M., Braithw. Br. M. Fl.) (Tab. XX. K.).

In close, flat patches, the stems short and more or less erect in the centre, prostrate and creeping towards the outside, yellowish-green, with crowded branches and *numerous very short lateral*

branchlets. Leaves patent and flexuose, appressed and very slightly twisted when dry, *from an oval-oblong base longly lanceolate, narrowly tapering*, but not very acute and often distinctly obtuse, *without a hyaline point, thin, pellucid*, lightly plicate at base; margin strongly recurved; *nerve very thin and faint, ill-defined*, vanishing below the apex; *cells all long, narrow and sinuose*, even those in the upper part of the leaf 3–5 times as long as broad and finely papillose, a single row, rarely two or three, of quadrate or rectangular hyaline cells forming a marginal band at the basal angles. Seta short, rather thick, brown; calyptra *papillose over the whole subula;* capsule oblong, dark brown, thick-walled; peristome teeth divided to base, divisions filiform.

HAB. Rocks, usually in subalpine situations. Frequent. Fr. spring and summer.

There is nothing very distinctive in the appearance of this species at first sight, but a more careful examination shows the leaves to be quite green to their tips, with no trace of a hyaline point; and its slender habit and narrow leaves will distinguish it from the last species, as will its mode of branching from the ordinary muticous-leaved form of *R. heterostichum*; in doubtful cases the cells, elongate to the apex of the leaf, and the very faint nerve will abundantly distinguish it, while the total absence of hair-point, dark seta, and larger brown, pachydermous fruit will equally separate it from *R. ramulosum*.

5. Rhacomitrium heterostichum Brid. (*Trichostomum heterostichum* Hedw.; *Grimmia heterosticha* C.M., Braithw. Br. M. Fl.) (Tab. XXI. A.).

Typically a rather short-stemmed plant, growing in close tufts, erect or more usually depressed, at the outside of the patches prostrate, rigid, greyish green, hoary; stems dichotomously branched *with few branchlets* which are usually slender and spreading rather than short and nodose; leaves spreading or subsecund, erect but not appressed when dry, *rather short and broad*, oblong-lanceolate from a wide base, gradually narrowed to a rather broad point, the summit of which usually has a hyaline tip with decurrent edges and is prolonged into a broad flat hair, which is denticulate at the margins, and often longer than half the rest of the leaf; leaf-margins revolute to apex, not or scarcely thickened above in the type; nerve distinct, reaching apex and passing into the hyaline point; lower cells linear, nodulose, a few at basal margin small, pellucid, upper gradually shorter, broader than in the last two species, *near apex shortly rectangular, rounded, or subquadrate*, usually $1\frac{1}{2}$–3 times as long as broad, shorter at margin, incrassate and sinuose, not papillose. Calyptra papillose at apex; seta straight, reddish, capsule oblong-cylindric, *narrowed at the mouth, thick-walled, brown*. Peristome teeth rather short, lanceolate, unequally divided.

Var. *β. alopecurum* Huebn. (*Grimmia affinis* Lindb., Braithw. Br. M. Fl. ; *Grimmia calvescens* Stirt. in Ann. Scot. Nat. Hist. x, 112 ; *G. fusco-viridis* Stirt., op. et loc. cit. ; *G. papillulata* Stirt., op. cit., xi, 110). *Slender and elongated*, with more numerous slender fasciculate branches ; less hoary, of a darker colour. Leaves more acute, *the hair-point shorter*, ¼ length of leaf, often almost obsolete ; texture more solid, cells of several marginal rows *bi-stratose* towards apex. Capsule *shorter*, peristome small.

Var. *γ. gracilescens* B. & S. (*G. affinis* var. *gracilescens* Lindb., Braithw. Br. M. Fl. ; *G. sublurida* Stirt. in Scot. Nat. ix, 36). *Still more slender*, with longer, often fastigiate branches, sometimes almost simple or only slightly dichotomous ; *hair-points very short, often wanting ;* cells as in var. *β* ; capsule still smaller, often paler and thinner-walled.

Hab. Rocks and walls in mountainous districts. Common. Fr. summer.

Rhacomitrium heterostichum is our most variable species, and the multiple forms are so inconstant and so ill-defined as almost to defy classification. They depend chiefly on the mode of ramification, the relative length, or absence, of the hair-point, the varying acuteness of the leaves, and the form, size, and texture of the capsule. There appears to be little or no correlation between these characters, and it is therefore unsafe to found even varieties on them. Thus forms with obtuse, muticous leaves occur correlated with the most widely different form of capsule and varying degrees of robustness and of branching, and I do not feel able to follow Lindberg and Braithwaite in making a species, nor indeed even a variety of the obtuse-leaved form. Moreover, it is not at all uncommon to find plants with the greater number of the leaves obtuse and muticous, with here and there one with a short hyaline point.

The var. *gracilescens* is with equal difficulty separated from the var. *alopecurum*, but I have taken it as embracing the slender forms with more or less dichotomous, not fasciculately branched stems, the leaves closely imbricated when dry, more frequently muticous and hairless, and the capsule smaller and paler. In some of its forms it shows a close approach to *R. sudeticum*. It is to be found abundantly all over the summit of Snowdon and several of the neighbouring mountains in large, deep tufts, almost black with taller or shorter, densely crowded, almost unbranched slender stems, nearly always barren.

Some forms have the upper margins distinctly thickened, which with the shorter, almost quadrate apical areolation, distinguishes the species from *R. ramulosum*, and also, in its muticous form, from *R. fasciculare*. It is more difficult to separate from *R. sudeticum*, although in its typical form widely different ; in the var. *gracilescens* the characteristic branching tends to disappear, the capsule becomes smaller, thinner and paler, and in short a very close approach is made to *R. sudeticum*.

R. heterostichum in its mode of growth is sometimes erect and not unlike a Grimmia, such as *G. trichophylla* or *G. decipiens ;* the broad base of the wide hyaline points is sometimes sufficient to distinguish it in the field, with the wider, less attenuated leaves : in the absence of these marks, and of the typical Rhacomitrium branching, recourse must be had to the microscope.

*** Rhacomitrium sudeticum** B. & S. (*Trichostomum sudeticum* Funck ; *Grimmia microcarpa* Lindb., Braithw. Br. M. Fl. ; *R. microcarpon* Brid. in part.) (Tab. XXI. C.).

Resembling slender forms of *R. heterostichum* var. *gracilescens*, in wide lax patches with ascending branches, dull or yellowish-green above. Leaves *small, narrowly acuminate, margin bistratose above*, nerve distinct ; hair-point *short* but usually distinct, narrow, denticulate. Areolation frequently a little wider and less sinuose at mid-base, but not constantly so ; *above roundish-quadrate*. Seta short, pale, flexuose or curved, calyptra slightly papillose at apex. Capsule *small, elliptic, pale brown, thin-walled ;* peristome teeth irregularly divided.

HAB. Shaded alpine rocks. Not common. Fr. early summer.

Although this is almost universally considered a separate species, I have little hesitation in uniting it with *R. heterostichum*. I can find no constant difference in the areolation of the two, nor in the other characters of the leaves. The slender habit and the branching are no doubt striking features, but *R. heterostichum* var. *gracilescens* is often every whit as slender, while it has, as noted above, every form of ramification : in the form and texture of the capsule it is equally variable, and I have forms which, on the basis of the fruit alone, would certainly be called *R. sudeticum*. The var. *validius* Jur., moreover, of *R. sudeticum*, appears to be in every way a transition to *R. heterostichum*.

*** Rhacomitrium ramulosum** Lindb. (*Grimmia ramulosa* Lindb., Braithw. Br. M. Fl. ; *R. microcarpon* Brid., Schp. Syn. ; *R. divergens* Stirt. in Ann. Scot. Nat. Hist. xvi, 179) (Tab. XXI. B.).

Smaller than *R. heterostichum*. In low pale green, rarely dark green or yellowish tufts, slightly hoary ; stems *slender, nodose, with very numerous short obtuse lateral branchlets*. Leaves thin and pellucid, lanceolate from an ovate base, gradually tapering to a not very narrow point, *with a flat, denticulate hair-point* variable in length, usually short ; margin recurved, *not thickened above ; cells all elongated and extremely narrow, 3–6 times as long as broad at apex ;* a few of the marginal row at extreme basal angles often *enlarged, wider, rectangular, hyaline or pellucid, not sinuose*. Seta short, pale, yellowish ; capsule *small, pale, thin-walled, oblong* or sub-cylindric ; calyptra papillose above ; peristome teeth short, deeply divided almost to base.

HAB. Dry mountain rocks. Scotch Highlands, rare. Fr. autumn.

Dr. Stirton sent me a specimen collected by him in the Island of Lewis in 1901, which certainly belongs to this species ; it has the short lateral branchlets, and the upper cells usually 4-6 times as long as broad, often longer, with the group of pellucid marginal cells at base well marked. The

same collector had it from several Scottish localities in his herbarium, and it has been collected once or twice by others. Boulay and Husnot unite it with *R. heterostichum* as a variety, but this seems scarcely justified, so long especially as *R. sudeticum* is maintained as a separate species; I cannot but think that the elongated upper areolation in the present plant is a character of greater importance than any which separates the former from *R. heterostichum*. It must however be admitted that this character is less constant and uniform than one could wish, and it is perhaps better to treat both *R. sudeticum* and the present plant as sub-species of *R. heterostichum*. In habit *R. ramulosum* resembles *R. fasciculare* to some extent, and in the densely nodose branching it even approaches *R. canescens*, while the hair-point is occasionally so developed as to render the plant quite hoary; the areolation and the presence of a hyaline point combined make it easy of recognition; in the fruiting characters it is near *R. sudeticum*, but the capsule is longer and darker, while the habit is quite different. So much doubt exists as to the plant intended by Bridel to be described by his name *R. microcarpon*, that it seems safer, and is far less confusing, to use Lindberg's name for the present species and *R. sudeticum* for the second of the two plants to which Bridel's name has equally been applied.

6. Rhacomitrium lanuginosum Brid. (*Trichostomum lanuginosum* Hedw.; *Grimmia hypnoides* Lindb., Braithw. Br. M. Fl.) (Tab. XXI. E.).

Growing in large mats, dull green or yellowish-brown, hoary, rigid and fragile when dry; stems procumbent, *3-12 inches long, slender, with numerous slender, variously elongated lateral branchlets*. Leaves crowded, spreading, often falcato-secund at the summit of the branches, appressed when dry, with the tip flexuose, *long, gradually narrowed from near the base to a very long tapering point*, the whole upper part forming a broad, *beautifully white diaphanous hair-point*, often longer than the rest of the leaf, longly decurrent at the sides of the leaf, *erose dentate* at margins, papillose on surface, flexuose and undulate when dry; leaf-base oval, slightly plicate; margin revolute below; nerve thin, broad, and distinct, running into the hyaline point, at the base of which it is chlorophyllose, above becoming hyaline but distinct almost to the apex; cells in one stratum throughout the leaf, arranged in regular rows, lowest very incrassate, narrow-linear and nodulose, a single row at basal margin of pellucid, not sinuose, narrow cells; upper cells broader, sinuose, shorter, but almost always *at least twice as long as broad*, even at the base of the hair, *smooth*. Capsule on a short, *rough* seta, arising on a short lateral branchlet, small, oval or elliptic-oblong, pale brown, finally darker; calyptra rough at apex; peristome orange red, the teeth divided to base into two long filiform branches.

HAB. Dry rocky heaths, wall tops, rocks, etc. Common. Fr. early summer, not common.

The largest British species of the genus, and quite distinct in habit alone. It is not very variable, but stunted forms occasionally are found which might at first be taken for *R. heterostichum*, and a variety occurs with very short

hair-points ; I have gathered a slender green form entirely without hair-points in moist spots on Ben More, Sutherland ; these forms are however easily known by the longer, more sinuose upper areolation, the habit, and other points ; from *R. canescens* the smooth cells of the leaf clearly separate it.

R. lanuginosum often covers tracts of barren heathland, in big swollen cushions ; it is one of the few species of the genus which, like the next, are occasionally found on the ground and not actually on rock. The hair-point of the leaf is a most beautiful microscopic object.

The fruit is not very frequently found, but when it occurs it is produced in considerable quantity. The rough seta is unique in this genus.

7. Rhacomitrium canescens Brid. (*Trichostomum canescens* Timm ; *Grimmia canescens* C.M., Braithw. Br. M. Fl. ; *Rhac. consocians* Stirt. in Ann. Scot. Nat. Hist. xvi, 179) (Tab. XXI. D.).

In lax or dense tufts, erect or spreading, dull green, or slightly yellowish ; stems 1–4 inches long, variously branched, *with few or many very short alternate branchlets*. Leaves variable in size and shape, but always *shorter and broader than in the last*, usually rather shortly acuminate from a *wide* ovate or almost cordate slightly plicate base, spreading, flexuose, when dry as a rule not much appressed, but variable ; usually, especially the upper ones, ending in a hair-point of variable length, rarely more than half the length of the leaf, broad, papillose, dentate, less decurrent than in the last, often very short or even wanting ; nerve *thin, pellucid, faint*, but usually distinguishable to the hair-point ; margin revolute ; cells all *strongly papillose*, unistratose, the upper *short, sub-quadrate*, sinuose, the lower long, narrow-linear, nodulose, a few at basal angles wide, thin-walled and pellucid, *forming minute decurrent auricles*. Seta long, *smooth ;* capsule elliptic or cylindric, slightly plicate when dry and empty, brown. Calyptra rough ; peristome very long, almost equalling the capsule.

Var. *β. cricoides* B. & S. Usually erect, stems straight, *lateral branchlets very numerous, short*, with a regular alternate or pinnate arrangement ; leaves usually broader and shorter, with a shorter hair-point.

HAB. Barren heaths and wall tops. Common. The var. *β* equally common, usually by sandy roadsides or in the detritus of stream beds. Fr. spring.

The peculiar ramification of this plant taken in conjunction with its normally long hair-points, and with its habit, usually makes its identification easy. It is, however, in some respects a very variable plant. I have very frequently found plants with the hair-point entirely wanting in nearly all the leaves, one form so exactly reproducing the appearance of *R. fasciculare* in colour, mode of growth, and leaf-form, that it can hardly be separated except by the papillose cells, shorter above and enlarged at the basal angles ; another with the leaves very broad, flaccid, strongly plicate, very shortly narrowed to an obtuse rounded apex. At times the hair-point is altogether wanting,

and the plants of a dark dull green. Under the microscope *R. canescens* is clearly marked off from the other species by the strongly papillose cells and minute auricles. It is less elongated in all its parts than the last.

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32. **COSCINODON** Spreng.

Characters of Grimmia, especially the species of the Section Schistidium, but differing in the *campanulate, plicate* calyptra; capsule *immersed* on a short seta, peristome teeth more or less perforated (cribrose). Dioicous.

Besides *C. cribrosus* there is another European species (*C. humilis*) with non-plicate leaves; a third species (*C. Patersoni* Ferg.) has been described as Scottish, but its record as a British plant was probably an error.

Deriv.—κοσκινο-(koskĭno) a sieve, and ὀδους (odous) a tooth; alluding to the perforated peristome.

1. **Coscinodon cribrosus** Spruce (*Grimmia cribrosa* Hedw.) (Tab. XXI. F.).

In small, very dense cushions, sometimes confluent and forming wide patches, *greyish*, hoary above, short. Leaves crowded, spreading, appressed when dry, ovate-lanceolate or shortly oblong-lanceolate, concave, margin incurved above; *plicate or rather costate at back on each side of the nerve*, especially in the upper part; nerve narrow, prominent at back; upper leaves ending in a *long, variably roughened, but usually almost smooth hair-point*, which is often wide at the base and extends down the upper part of the leaf apex; cells at base *rectangular*, rather pellucid, *not sinuose*, thin-walled or slightly incrassate, more elongated near the nerve; above elliptical, then rounded, or quadrate, incrassate, smaller, near apex often bi-stratose; perichaetial bracts thinner, less plicate. Seta short, capsule *immersed*, erect, oval, smooth, wide-mouthed when dry, lid conical, rostellate; calyptra covering most of capsule, lobed at base, thin; peristome teeth *lanceolate, orange-red, much perforated*.

Hab. Siliceous rocks, very rare. Fr. summer.

This little moss resembles *Grimmia anodon* and *G. crinita* in its dense, grey, velvety cushions; but the capsule is different and the plicae of the leaves at once distinguish it. These are rather dorsal bands of thickening cells with something the appearance of secondary nerves than simple furrows; they are sometimes very indistinct. The species differs too from the above plants in never choosing a calcareous matrix. *Grimmia conferta* is also something like it, but the denser tufts, the calyptra, the larger basal cells, and plicate leaves with plane margins of the present plant will easily distinguish it from that.

33. PTYCHOMITRIUM B. & S.

Plants in dense cushions; leaves *long, narrow, without hyaline points, crisped when dry;* areolation not sinuose. Seta *straight.* Capsule smooth. Calyptra *campanulate*, lobed, *plicate.* Peristome teeth long, divided *into two slender branches or almost entire.*

DERIV.—πτυχο-(ptycho) a fold or wrinkle, and μιτριον (mitrion) a cap. Alluding to the plicate calyptra.

1. Ptychomitrium polyphyllum Fuernr. (*Bryum polyphyllum* Dicks.; *Glyphomitrium polyphyllum* Mitt., Braithw. Br. M. Fl.) (Tab. XXI. G.).

In neat *rounded dense cushions, ½–2 inches high*, dark or yellowish-green, blackish below. Leaves crowded, spreading and flexuose when moist, *strongly crisped when dry, large* (2 lines long), elongate-lanceolate from a broad, oblong, *deeply plicate* base, tapering to an acute but not slender nor hyaline point, margin revolute in the lower half, above plane, incrassate, *coarsely and remotely toothed in the upper half;* nerve strong, channelled in front, rather indistinct towards apex; cells at base very narrow and long, regularly seriate, with thick lateral and thin transverse walls, towards the margins wider, shorter; reddish brown at base; above, the cells gradually shorten, the walls becoming uniformly incrassate, in all upper part of leaf rounded-quadrate or transversely oval, very regularly arranged in rows, brown and opaque. Seta erect, straight, *about half an inch long*, but variable, several often arising from the same perichaetium; capsule *narrowly elliptic or sub-cylindric, pale brown*, thin-walled, smooth; lid longly and finely subulate; calyptra *narrowly campanulate*, lobed at base, plicate, slightly scabrous at apex. Peristome teeth cleft to base, red, paler when old, *erecto-patent, segments long, filiform.* Spores small. Autoicous.

HAB. Siliceous rocks and walls in mountainous districts. Common. Fr. early summer.

A very distinct and easily-known plant, the neat cushions with the capsules usually very abundant, being conspicuous on nearly every wall in many mountain regions; the stems are thick and tumid with the large, densely-crowded leaves. The serratures of the leaves are sometimes very faint. The basal areolation is peculiar, the regular rows of linear cells with very thin transverse walls, but strongly incrassate longitudinal ones, giving frequently somewhat the appearance of each row being a single cell with transverse partitions rather than a series of separate cells.

34. GLYPHOMITRIUM Brid.

Closely allied to Ptychomitrium, but of much smaller habit ; peristome teeth *united in pairs, broad, entire.*

The difference in peristome seems sufficient to warrant the separation of these two genera, which in other respects too would seem the more natural treatment.

Deriv. γλυφο-(glypho) sculptured, and μιτριον (mitrion) a cap ; from the furrowed calyptra.

1. Glyphomitrium Daviesii Brid. (*Bryum Daviesii* Dicks. (Tab. XXI. H.).

In small dense smooth cushions, *about half-an-inch high,* deep green. Leaves *small* (1 line), narrowly linear-lanceolate, tapering to a rather broadly acute point, *crisped when dry,* margin plane or narrowly recurved below, thickened above, *entire ;* nerve strong, thick, vanishing at apex ; cells at base *hyaline, thin-walled, hexagonal-rectangular,* rather shorter at margin, above elliptic, incrassate, in all the upper half rounded-quadrate, regularly seriate, incrassate. Seta very short, *1–2 lines,* capsule small, *oval-globose,* pale reddish brown with a red mouth, when dry and empty wide-mouthed and sub-urceolate ; lid longly rostrate ; peristome teeth red, in pairs, broad, *lanceolate, reflexed when dry, entire,* closely barred, inserted below the mouth. Calyptra whitish, at first narrow, plicate, reaching below the capsule and embracing the seta, afterwards *inflated,* shining and hardly plicate, split at several points, on one side almost to apex. Spores large, 30–40 μ. Autoicous.

Hab. Basaltic and siliceous rocks. Rare. Fr. summer.

A pretty little plant, readily known by its small compact tufts, curled leaves and numerous minute reddish capsules, with white shining calyptra. Without the latter organ it bears a slight resemblance to Rhabdoweisia, but the similarity is only superficial. It grows well on the basaltic pillars of the North of Ireland and the West Coast of Scotland, and is also found in Wales and England, but has only been discovered, beyond the British Isles, in the Faeroes.

35. CAMPYLOSTELIUM B. & S.

Minute, gregarious plants ; leaves small, *very narrow,* crisped when dry, areolation punctate above. Seta *arcuate,* capsule small, calyptra *mitriform, smooth.* Peristome teeth narrow, cleft, equidistant.

A small genus, the place of which is somewhat uncertain ; it is usually placed near Seligeria, to which it has close affinity, but in leaf structure and in the mitriform calyptra and peristome it comes very near Glyphomitrium and Grimmia.

DERIV.—καμπυλο-(kampylo) bent, and στελεον (stĕleon) a handle; from the arcuate seta.

1. Campylostelium saxicola B. & S. (*Dicranum saxicola* W. & M., *Glyphomitrium saxicola* Mitt., Braithw. Br. M. Fl.) (Tab. XXI. I.).

Minute, dwarf, gregarious; leaves crowded above, *longly linear-subulate* from a narrow oblong base, sub-acute, flexuose, *crisped when dry;* margin plane, entire, slightly incrassate above; nerve rather stout, vanishing in apex; cells at base lax, hyaline, thin-walled, rectangular; above smaller, elliptic, incrassate, in the limb *small, rounded*, often bi-stratose, incrassate. Seta slender, *cygneous*, when mature and dry erect and flexuose; capsule *elliptic-oblong*, pale, thin-walled, smooth; calyptra subulate, lobed; lid longly rostrate; peristome teeth reddish, unequally cleft. Autoicous.

HAB. Sandstone and siliceous rocks; not common. Fr. winter.

The distribution of this little moss is very much that of *Brachyodus trichodes*, with which, moreover, it is frequently found growing. The seta, which even when mature becomes bent again upon moistening, and the smooth capsule, are sufficient to distinguish it. In habit it is most like *Seligeria recurvata*, but that has more setaceous leaves with different areolation, and a shorter, rounded capsule.

36. HEDWIGIA Ehrh.

Stems forked, with lateral innovations. Leaves broad, *oval, nerveless*. Capsule *immersed* or very shortly exserted, roundish, *gymnostomous;* calyptra *small, fugacious;* lid short, obtuse.

A genus consisting of two species, which has been variously located, but seems most at home under Grimmiaceae. These two species are sometimes treated as generically distinct, but the distinguishing characters are not of great importance, and I have adopted the other, perhaps less usual arrangement. The leaves have some resemblance in form and areolation to those of *Cryphaea heteromalla*, but there the agreement ends.

DERIV.—After Hedwig, the "Father of Bryology."

{ Leaves with hyaline points, coarsely papillose.....*1. ciliata*
{ Leaves without hyaline points, scarcely papillose.....*2. imberbis*

1. Hedwigia ciliata Ehrh. (*Bryum ciliatum* Dicks.; *Hedwigia albicans* Lindb.) (Tab. XXII. A.).

In small or wide patches, of a *glaucous green, and usually hoary*, the tufts very easily breaking up when gathered. Stems

rather slender, at first erect, then elongated and procumbent, rigid when dry, slightly forked and with shorter lateral branches, 1–4 inches long, denuded at base. Leaves when dry *imbricated with the apex recurved, often falcato-secund*, when moist spreading, often secund especially on the procumbent stems, concave, nerveless, ovate, *acuminate and tipped with a long or short, wide, hyaline point*, which is spinosely denticulate at the edges; margin *recurved below*, slightly sinuose; *cells strongly papillose*, at mid-base yellow, narrow-linear with the lateral walls incrassate and somewhat porose; towards the margin the cells are shorter, wider, sub-quadrate or rectangular with sinuose walls, more pellucid, at basal angles often larger, quadrate, brown; upper cells in regular longitudinal rows, *ovate, hexagonal or sub-quadrate*, all incrassate and usually angular. Capsule *sub-sessile*, immersed; perichaetial bracts *ciliate* on the margin towards apex; calyptra small, only covering the lid, conical, usually sub-cucullate, fugacious; capsule globose or slightly oblong, wide-mouthed and truncate after the fall of the lid, yellowish with a red mouth, smooth, annulus none; lid *convex, sometimes mamillate;* peristome none. Autoicous.

Var. β. *leucophaea* B. & S. More robust, *very hoary;* leaves wider, the hyaline base of the hair-point occupying *almost one-third of the length of the leaf.*

Var. γ. *viridis* B. & S. Leaves imbricated when dry, *bright green, tip hardly hyaline.*

Var. δ. *striata* Wils. Leaves (especially the uppermost) distinctly *striate;* margin strongly recurved.

HAB. On siliceous walls and rocks, common. The var. β on more exposed rocks. The var. γ in more shaded localities rare. The var. δ rare. Fr. spring.

This species is somewhat variable, especially in the relative length and conspicuousness of the hyaline point; the vars. *viridis* and *leucophaea* are little more than extremes of variation in this respect, linked with one another by innumerable intermediate forms. Another form described by Schimper as var. *secunda* is also found; it is only a more than usually elongated slender form with smaller, less crowded, more secund leaves than usual.

Hedwigia ciliata somewhat resembles *Rhacomitrium heterosticium*, and still more perhaps *Grimmia apocarpa*, but the broader ovate nerveless leaves regularly imbricated, at the base at least, when dry, are totally different upon closer examination. Forms without hyaline points, which are however rare, might be taken for the next species, but are nearly always of a decided green, less yellow; it would always be safer, however, to submit such forms to the microscope, when the strongly papillose leaves would clearly refer them to the present species.

2. Hedwigia imberbis Spruce (*Gymnostomum imberbe* Sm.); *Hedwigidium imberbe* B. & S., Schp. Syn. et plur. auct.) (Tab. XXII. B.).

Resembling the last species in mode of growth, but with the stems less forked, with lateral branches, sometimes flagelliform,

dark brown below, yellowish brown at the summits of the branches, not hoary; leaves spreading, rarely falcato-secund, *closely imbricated when dry*, resembling the last in shape, oval-oblong, quickly narrowed to a *short acute apiculus, not hair-pointed*, nerveless; margin *strongly revolute almost to summit*, slightly notched or irregular at apex. Basal cells resembling the last, the upper smaller, *narrower, usually irregularly rectangular and elliptic, or sub-quadrate*, with incrassate sinuose walls, *smooth or slightly papillose*. Leaves of the flagelliform shoots and perichaetial bracts with the apex sometimes discoloured. Perichaetial bracts not ciliate. Capsule *on a rather longer seta*, but scarcely emergent, lightly longitudinally furrowed when dry; lid *conical-rostellate*, calyptra small, cucullate or sub-cucullate. Autoicous.

HAB. Siliceous rocks, rare. Fr. very rare, autumn.

Usually easily distinguishable from the last by the absence of hyaline points to the leaves, which are almost always brown or yellowish, more imbricated when dry, with the margin more strongly recurved; also by the smoother, smaller and narrower areolation.

ORDER IX. TORTULACEAE.

Mosses usually of low growth, radiculose only at base. Leaves variable, from linear to spathulate; areolation usually thin-walled and hyaline at base, often small, obscure and papillose above. Seta straight, rarely curved in the more minute plants, capsule erect or slightly inclined, oval, oblong or cylindrical, calyptra usually narrow and cucullate, peristome none or single, of 16 straight or spirally twisted teeth, entire or divided, often into 32 filiform branches, papillose.

A large and polymorphous Order, very difficult to define, owing to the number of lowly organised forms which, while widely differing from the normal type of the Order, are clearly inseparable from it by reason of the regular gradation between them and the higher species. The structure of the leaves is more important, perhaps unusually so, than that of the peristome, which exhibits considerable variation even within the same genus, and is, indeed, often absent from species whose close relationship with other highly peristomate ones is undoubted. On one side Tortulaceae comes very near to Dicranaceae, especially through Ceratodon; on another it approaches Funariaceae; the higher species of Tortula show great affinity to Encalypta, while Cinclidotus is related to Grimmiaceae, and other relationships could be pointed out; in a linear arrangement it is impossible to preserve these affinities unbroken, and we are obliged to be contented with drawing

attention to the more important of them. With some slight variation I have for the most part followed Lindberg's generic divisions and arrangement. I have, however, united Ephemerum with the Funariaceae, as, despite its near resemblance to Acaulon, it appears to be quite as closely related through Physcomitrella with that Order, and the areolation is rather Funarioid than Pottioid.

Tribe 1. Pottieae.

Leaves broad in outline, in only a few species narrowly lanceolate; peristome when present of 16 or 32 teeth, entire or cleft, sometimes to base, straight or twisted, often united at base into a tube. Upper cells more or less hexagonal, lax and pellucid or rather smaller and obscure; rarely minute; the basal lax and hyaline.

37. ACAULON C.M.

Plants *minute*, bulbiform. Upper leaves *very much larger, concave, convolute*. Capsule spherical, *almost or entirely without an apiculus, immersed, cleistocarpous*. Calyptra *very small*, conical, irregularly torn at the base. Spores rather large, granulated. Columella perfect. Male flower on a basal branch or basal radicles.

These little plants are in the areolation somewhat intermediate between the genera Ephemerum and Phascum; in habit, however, they are much nearer the latter, especially *P. cuspidatum*, and it can hardly be doubted that they are rightly placed here, whatever the position of Ephemerum. From all species of Phascum and indeed from all the cleistocarpous mosses with which they are likely to be confused, the round capsules without distinct apiculus or only a very minute one, and the inflated, usually denticulate bracts easily distinguish them.

DERIV.—ἀ-(a) without, and καυλος (kaulos) a stem. "The stemless moss."

Perichaetial bracts convolute, folded one within the other, not keeled; seta straight ..... *1. muticum*
Perichaetial bracts meeting one another at the margins, keeled; seta arcuate ..... *2. triquetrum*

1. Acaulon muticum C.M. (*Phascum muticum* Schreb.; *Sphaerangium muticum* Schp. Syn.) (Tab. XXII. C.).

Gregarious, minute plants, *oval in outline and slightly cuspidate* by the rather elongated upper leaves or bracts, pale greenish white

or yellowish. Lower leaves very small, concave, roundish-ovate ; about three upper much larger, *the two uppermost* or inner perichaetial bracts being the largest, *convolute, cymbiform, rounded at back, not keeled*, enclosing and covering the capsule ; *irregularly denticulate or sinuose* at the rounded obtuse apex, nerve distinct, usually excurrent in a short *erect mucro*, margin plane ; lower cells hyaline, rectangular, thin-walled, rather large, the upper smaller, rhomboid-hexagonal or sub-rectangular, *smooth*, the marginal ones often forming a more or less distinct border. Capsule on a *short straight seta*, immersed, spherical, or with a minute obtuse apiculus, orange-brown ; calyptra very small, torn at the base. Male flower on a basal branch or basal radicles. Spores 30–40 μ, finely granulated.

Var. β. *minus* H. & T. *Smaller, shorter*, bracts hardly exceeding the capsule, more shortly pointed, *entire*.

HAB. Bare sandy spots, not unfrequent. The var. β, Torquay ; Sussex. Fr. winter and early spring.

Somewhat variable in size and in serrature of the bracts, this plant may always be recognised by the rounded, not apiculate capsule, and the large bracts folded together and concealing the fruit, not spreading and open as in Phascum ; the cells, too, are usually more elongated and rhomboid, and smooth. From *A. triquetrum* it differs in the more elongate plants, more acute in outline, with the nerve of the leaves straighter, less conspicuous, not recurved in the mucro. The upper cells in both species are slightly incrassate, but not markedly so.

In the first edition of this work I included *A. mediterraneum* Limpr., to which Braithwaite referred plants gathered at Douglas, I. of Man, by Holt in 1886. I have not seen original specimens of Limpricht's plant, but careful comparison of his description with that given by Braithwaite and with the I. of Man moss itself shows, I think, that we have to do with two distinct plants. The main characters that Limpricht relies upon in *A. mediterraneum* are the perichaetial bracts not meeting towards apex (so that the capsule is visible from above), plane and entire at margin, the very short, not curved seta, and the spores echinulate (covered with elevated, acute papillae) as compared with the granulated surface in *A. muticum*. These were, it is true, very nearly the characters attributed by Lindberg to his *A. Holtii* (ined.), but they do not agree either with Braithwaite's description or with the I. of Man specimens. The bracts in the specimens which Mr. Holt kindly sent me are constantly more or less denticulate, the spores minutely granulated exactly as in *A. muticum*. The apiculus to the capsule which Lindberg also relied upon is not mentioned by Limpricht, nor is the inequality of the perichaetial bracts, or the slender curved outline of the plant, which Braithwaite emphasises. Our plant, then, cannot, I think, be identical with the continental moss described by Limpricht, and *A. mediterraneum* Limpr. must be dropped from our list. Considering also the variability of the apex of the perichaetial bracts in *A. muticum*, and taking into account the inconstancy, as far as my experience goes, in our plants, of the other characters relied upon by Braithwaite, I do not think it is desirable on the whole to create a fresh variety for the form found in the I. of Man and elsewhere in Britain.

2. Acaulon triquetrum C.M. (*Phascum triquetrum* Spruce; *Sphaerangium triquetrum* Schp. Syn.) (Tab. XXII. D.).

Resembling the last but *smaller*, often golden brown; the plants bulbiform, *almost globose, rounded and obtuse in outline;* the bracts rather more numerous, *usually three, acutely carinate* so as to give a triquetrous outline to the plant when viewed from above; the nerve strong, excurrent in a *recurved apiculus*, the upper margin slightly recurved. Capsule on an *arcuate* seta. Spores rather smaller, 25–30 μ, rarely 35 μ.

HAB. On the ground on the south coast; very rare. Fr. early spring.

Distinguishable from the first species by the characters italicised above, although somewhat approached by the var. *minus* of that plant.

38. PHASCUM Schreb.

Minute, *cleistocarpous* plants. Leaves *entire*, ovate or lanceolate, upper areolation usually *papillose*. Calyptra cucullate. Capsule immersed or slightly exserted, sub-globose or oval, *with a small apiculus*. Columella perfect. Male flowers axillary.

DERIV.—*φασκον*-(phascon), a Greek name for some indeterminate cryptogamic plant.

1 { Capsule immersed, or slightly emergent only 2
  { Capsule exserted on a curved seta ..... *3. curvicolle*

2 { Plant green; ls. oblong-lanceolate ..... *1. cuspidatum*
  { Plant brownish; ls. ovate-acuminate ..... *2. Floerkeanum*

1. Phascum cuspidatum Schreb. (*P. acaulon* L., Braithw. Br. M. Fl.) (Tab. XXII. E.).

Densely tufted; minute, but larger than the other species of this genus, or of the last; *deep green;* stems about 1 line high, occasionally taller, sometimes forked. Leaves crowded, *erect*, gradually larger upwards, the upper *oblong-lanceolate*, narrowed to apex, carinate, *somewhat twisted when dry;* nerve excurrent in a point of variable length; margin entire, *revolute towards the middle;* areolation lax and hyaline at the base, rectangular; above hexagonal, rhomboid or rectangular, 18–27 μ in diameter, rectangular cells occasionally 32 μ, finely papillose at back. Capsules single, or two or three together, on straight or arcuate pedicels of varying length, *immersed or very slightly emergent, roundish with an obtuse apiculus;* calyptra conical, cucullate; spores moderately large, 28–35 μ, yellow, finely granulated. Autoicous or paroicous; antheridia several together in the axils of the upper leaves, usually enclosed in one or two small bracts, but not forming a distinct bud or flower.

Var. β. *piliferum* Hook. and Tayl. (*P. piliferum* Schreb.). Smaller, leaves shorter, reddish, *piliferous with the longly excurrent nerve.* Capsule *large,* immersed.

Var. γ. *Schreberianum* Brid. (*P. Schreberianum* Dicks.). *Tall, several times branched ;* leaves longer, the uppermost spreading ; *capsule slightly emergent.*

Var. δ. *curvisetum* Nees & Hornsch. (*P. curvisetum* Dicks.). Tall ; often divided ; capsule *emerging laterally on an arcuate seta.*

HAB. Clay banks, waste places, and fallow fields. Very common. The vars. rare. Fr. early spring.

An extremely variable plant in size, habit, and other points. The var. *piliferum* is, perhaps, the best characterised and most stable variety, the other two are rather the extreme forms each of a more or less connected series of gradations, many of which may be seen on the same tuft, or even on the same plant. The var. *piliferum* grows on sandy soil in dry places, usually near the sea, and has the hair-points not unfrequently hyaline and hoary. It was considered a species by Schreber, and even several varieties of it have been described.

P. cuspidatum, in addition to other characters mentioned under *Acaulon muticum,* may usually be known from that species by the more numerous leaves more or less twisted when dry, with longer points. It is more common than any of the allied species, and usually grows in greater quantities and in more crowded tufts. *Pottia bryoides* resembles it closely in vegetative characters.

A small brown form, usually growing on clay, may be taken for *P. Floerkeanum;* but the much larger cells will separate it under the microscope.

2. Phascum Floerkeanum W. & M. (Tab. XXII. F.).

Very minute, gregarious, *reddish brown.* Leaves *erecto-patent,* the upper larger, but not markedly so as in Acaulon, *slightly twisted when dry,* concave, *ovate-acuminate,* stoutly cuspidate with the strong reddish nerve ; margin *slightly revolute above,* entire, or faintly irregular with the transverse cell-walls slightly projecting, cells lax at base and pellucid, hexagonal-rectangular, the upper small, 13–15 μ wide, irregularly quadrate, rhomboid or hexagonal, minutely papillose at back. Seta *very short, erect.* Capsule *immersed,* small, rounded with an obtuse apiculus, reddish ; calyptra conical, sub-cucullate ; spores *pale,* very minutely granulated, almost smooth, 20–25 μ.

Var. β. *badium* Brid. (*P. badium* Voit). Leaves *longer,* narrower ; capsule *smaller,* ovate, *dull brown.*

HAB. Clay and chalk fields, uncommon. The var. rarer. Fr. winter.

One of the smallest of our mosses. It is known from small forms of the last by the reddish colour, and shorter, more acuminate leaves, which are more spreading above, whereas in that species they are more or less erect. From the next it differs obviously in the straight, short seta and immersed capsules. The latter are occasionally aggregate.

3. Phascum curvicolle Ehrh. (Tab. XXII. G.).

Very minute, gregarious, brownish. Leaves crowded, the lower small, oblong-lanceolate, the upper larger, *narrowly lanceolate*, acuminate, nerve reddish, stout, excurrent into a long point; margin *recurved for the greater part of the length of the leaf*, entire or minutely crenulate-papillose at apex; cells rectangular at base, above small, rounded-hexagonal or sub-quadrate, very papillose, obscure, *incrassate;* capsule *laterally emergent on a curved seta*, solitary or aggregate, horizontal or pendulous, *oval* with an obtuse point, bright brown, glossy; calyptra rather large, cucullate. Spores 24–28 μ, *pale*, very faintly granulated. Paroicous or synoicous.

Hab. Bare places and fallow fields, usually on chalky ground. Rare. Fr. early spring.

Readily known by its oval almost pendulous capsule hanging out from the side of the stem, and often more conspicuous than the rest of the plant; the areolation, too, is denser and more obscure than in *P. cuspidatum*, the var. *curvisetum* of which is the only plant that when in fruit might be mistaken for it, and the spores are different. The leaves are smaller and narrower than in the last.

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39. POTTIA Ehrh.

Plants *short*, hardly branched, in tufts or scattered. Leaves *broad in outline*, more or less ovate or oblong, usually papillose, nerved almost always to apex or beyond; areolation rather lax, *more or less hexagonal above*. Calyptra narrow, *cucullate*. Capsule *erect on a straight seta, exserted, oval or cylindric*, cleistocarpous, gymnostomous, or with a peristome of 16 imperfect or lanceolate bifid teeth. Spores granulated, usually large.

The species of this genus form a very natural group, and the only real question of difficulty is whether they should stand alone or form a section of Tortula. The convenience of the former arrangement is obvious, since there are as many as 40 species belonging to Pottia, and a still larger number to Tortula, and although there is no doubt considerable affinity between the two groups, it can hardly be considered closer than is often the case between allied genera; there is, moreover, a peculiar habit among the Pottiae which is only found in a few species of Tortula, and which is there always associated with the elongated fruit and characteristic peristome of that genus. It is true that *Tortula pusilla* and *T. lamellata* form a connecting link between the two genera, and that the two being obviously inseparable, one must be removed from what would certainly be its natural place did it

stand alone ; but the existence of such ambiguous forms is a rule rather than an exception in nature, and to deny autonomy to all groups that included such forms would be to reduce classification to an absurdity.

On the other side Pottia runs closely into Phascum, and the line between them must needs be a somewhat arbitrary one.

In Pottia the stems are usually very short, and never much elongated ; the leaves are generally soft, and mostly spread in a stellate manner from the stem when moist ; the capsule and seta are almost always shorter than in Tortula, and the peristome teeth are never filiform and elongated as in that genus.

The quinquefarious or octofarious arrangement of the leaves, while no doubt of some value as a character, and fairly easy of determination in fresh plants, is not of much use in the study of herbarium specimens ; and even with the former it is sometimes difficult, and occasionally, I am inclined to think, misleading. *P. lanceolata* for instance though usually quinquefarious is at times octofarious.

DERIV.—After Pott, once Prof. of Botany in Brunswick.

1 { Lid very minute, persistent....2
  { Lid larger, deciduous....3

2 { Capsule sub-globose ; calyptra rough at apex....*1. recta*
  { Capsule elliptic ; calyptra smooth....*2. bryoides*

3 { Peristome absent, or rudimentary....4
  { Peristome present....11

4 { Ls. serrulate at apex, nerve usually vanishing....*3. Heimii*
  { Ls. entire, nerve excurrent....5

5 { Lid conic ; leaves ovate-lanceolate....*7. minutula*
  { Lid beaked ; leaves oblong or obovate....6

6 { Capsule short, turbinate ; ls. quite smooth....*4. truncatula*
  { Capsule more or less oval or elliptic ; ls. usually papillose....7

7 { Ls. with rather long hair-points, ⅓ length of leaf....*5. crinita*
  { Nerve excurrent in a short point....8

8 { Calyptra scabrous above....9
  { Calyptra smooth....10

9 { Capsule oval ; upper cells rather lax....*6*. asperula*
  { Capsule long-elliptic ; upper cells small....*6. Wilsoni*

10 { Ls. oblong, in 5 ranks ; peristome rudimentary....*4*. intermedia*
   { Ls. obovate-spathulate, in 8 ranks, very green ; peristome absent *5*. viridifolia*

11 { Nerve vanishing ; ls. broad, in a bulb-like tuft....*11. latifolia*
   { Nerve excurrent....12

12 { Lid conic ; calyptra scabrous above....13
   { Lid rostrate ; calyptra smooth....14

13 { Spores coarsely tuberculate....*8. Starkeana*
   { Spores finely papillose....*7*. commutata*

14 { Nerve excurrent in a rather long point ; cells lax....*10. lanceolata*
   { Nerve excurrent in a short mucro ; cells small....*9. caespitosa*

1. Pottia recta Mitt. (*Phascum rectum* With., Schp. Syn.) (Tab. XXII. H.).

Very small, gregarious, dull green or brownish. Leaves erecto-patent, slightly recurved, *small*, concave, oblong-lanceolate or ovate, shortly acuminate and rather acute, nerve strong, reddish, excurrent in a short mucro, margin recurved, entire, cells rectangular and hyaline at base, above *small*, 10–14 μ, rarely 18 μ, rhomboid or hexagonal, papillose, chlorophyllose. Capsule on a *very short*, straight or slightly curved seta, not much elevated above the leaves, *cleistocarpous*, small, *sub-spherical with a very small obtuse apiculus* formed by the lid, which does not however separate, orange-brown; capsules occasionally aggregate; calyptra *scabrous* above, and indeed nearly to base; spores finely spiculose-papillose. Paroicous.

Hab. Bare places and fallow fields, usually on calcareous soil, sometimes on clay; not common. Fr. winter.

This species is nearly allied to *Phascum curvicolle*, but the erect or almost erect seta and distinct though not deciduous lid make it easily recognised, and the upper leaves are shorter and broader, the calyptra also is more scabrous. In habit it is more like *P. Starkeana*, or *P. minutula*, but the deciduous lid and especially the wide-mouthed capsules in those species readily distinguish them; in the present plant the lid and its line of union with the capsule are very small and narrow. The next species is known by the smooth calyptra and more elongate capsule.

2. Pottia bryoides Mitt. (*Phascum bryoides* Dicks., Schp. Syn.) (Tab. XXII. I.).

Taller than the last, sometimes nearly half-an-inch in length, dull green, densely gregarious. Lower leaves small, lanceolate, *upper much larger*, broadly oblong-lanceolate, concave, acuminate, margin revolute to near apex, nerve excurrent in a short arista; upper cells *larger* than in the last, 17–22 μ, hexagonal-rhomboid, incrassate, smooth or more or less papillose. Capsule *cleistocarpous*, exserted on a short seta, about one line high, or less, *oval or oval-elliptic*, abruptly or gradually narrowed into an obtuse persistent rostellate beak; calyptra *smooth*; spores as in the last. A rudimentary peristome is present. Autoicous; male flower distinct, near the base of the fertile stem.

Var. β. *Thornhillii* Wils. Leaves *much longer*, sub-spathulate, spreading and slightly recurved, *margin plane*, nerve very shortly excurrent. Capsule *longer*, with a long beak, on a longer seta. Spores smaller, slightly granulated.

Hab. Fallow fields and bare places, rare. The var. β near Newcastle (*Thornhill, 1841*). Fr. winter.

The capsule in this species is of a peculiar form, as is best shown by the figure. Sometimes, however, it more closely resembles that of the last species, but is larger and longer. That species has smaller leaves with much smaller areolation, more papillose and obscure ; indeed, the foliage of *P. recta* is rather Phascoid than Pottioid. The fruit, however, will readily separate them.

The var. *Thornhillii*, which I have not seen, was by Wilson considered as possibly a distinct species, and the characters as detailed by him are certainly striking.

P. bryoides is a variable species, and other forms have been described as varieties, but apparently on slender grounds ; one form (var. *pilifera*) has the nerve excurrent in a long hair-like point.

Immature plants of *P. bryoides* with the capsules more or less developed but still enclosed in the bracts may be overlooked as *Phasc. cuspidatum ;* I have found the two in company and not at all easy to distinguish at this stage. The position and character of the male flower will separate them in such a case, and probably in all cases the form of the capsule also.

Limpricht created the genus Mildeëlla for this species on account of the presence of a rudimentary peristome. It is as a rule only to be detected by careful section cutting, but Mr. W. E. Nicholson has observed it in certain cases through the capsule wall after treatment with liquor potassae, and has even been able to get away the teeth separately in a mature capsule. They are extremely delicate, thread-like, yellowish, papillose and jointed.

3. **Pottia Heimii** Fuernr. (*Gymnostomum Heimii* Hedw.) (Tab. XXII. J.).

A comparatively *tall* species, with the stems $\frac{1}{4}$–$\frac{1}{2}$ inch high, but variable in this as in other respects ; tufted, yellowish or deep green. Leaves increasing in size upwards, lower broadly lanceolate, those at the top of the stem *long, narrowly oblong-lanceolate, acute* and slightly acuminate, spreading when moist, appressed and slightly twisted when dry ; margin *plane, serrated towards apex ;* nerve reddish, usually not excurrent ; cells in the lower half of the leaf elongated, rectangular, lax, hyaline ; in upper part *rather large*, hexagonal-rhomboid, chlorophyllose, rather incrassate, papillose. Seta *long* ($\frac{1}{4}$–$\frac{1}{2}$ inch), *rather thick*, twisted when dry ; capsule obovate-oblong, rather large, but variable, thick-walled, narrowed at base, brown, wide-mouthed when empty ; calyptra *smooth ;* lid *obliquely rostrate* from a broad flat base ; *columella attached to lid*, at maturity lengthened beyond the mouth of the capsule, elevating the lid and retaining it for some time ; peristome *none*. Autoicous or rarely synoicous.

HAB. Muddy and sandy ground near the sea ; very rarely inland. Frequent. Fr. spring.

This is one of our few distinctly maritime mosses ; it somewhat resembles robust forms of *P. intermedia*, but it has a different habit from any of the other species, by which it is easily recognised, the long, stout seta greatly contributing to this. It is also in its typical form quite distinct in the leaf apex, although among its many variations it occasionally has the leaves entire ; it is, however, rarely that it may not be known by this character.

The lid, elevated above the mouth of the capsule and remaining attached to the columella, is a very curious and striking characteristic of this species during the time that the fruit is mature.

The plane, toothed margin of the leaf would distinguish doubtful or barren forms from *P. intermedia*; the leaves are also usually of a more solid texture than in the allied species.

A form occurs with entire leaves, having the nerve ceasing below the apex; it may possibly be *P. Rvani* Philib. It requires further study.

4. Pottia truncatula Lindb. (*Bryum truncatulum* L.; *Pottia truncata* Fuernr., Schp. Syn.) (Tab. XXII. K.).

In loose tufts or patches, dull green; ¼–inch high, slightly branched. Leaves quinquefarious, spreading, soft, twisted when dry, lower short, oblong-spathulate, upper longer, oblong, shortly and slightly acute; *margin plane*, slightly irregular towards apex with the projecting transverse cell walls, but not papillose; nerve excurrent in a short point; upper cells *rather large*, hexagonal, thin-walled, *smooth*. Seta short, slender; capsule *shortly oval or turbinate, when empty truncate, wide-mouthed and almost hemispherical*, thin-walled, pale brown, exannulate; lid flat, with a very oblique, more or less longly rostrate beak. Calyptra *smooth*. Peristome none. Spores large, 20-28 μ, minutely punctulate. Autoicous.

Hab. Banks, fallow fields, etc., very common. Fr. autumn and winter.

The commonest species of the genus, and recognised without difficulty by the leaf form and the short truncate capsules with obliquely rostrate lid. The capsule is, however, somewhat variable in length and form.

*** Pottia intermedia** Fuernr. (*Gymnostomum intermedium* Turn.; *P. lanceolata* var. *gymnostoma* Schp. Syn.) (Tab. XXIII. A.).

Taller, rather larger in all its parts; leaves longer, *margin revolute at middle*, at apex slightly rough with projecting papillae as well as with the transverse cell walls; areolation usually *slightly papillose* at back in the upper part of the leaf. Capsule longer, *oblong*, more or less elongated; peristome absent or very rudimentary. Annulus broad.

Var. β. *littoralis* (*P. littoralis* Mitt.). Tall, of a *bluish or glaucous green*; leaves usually longer, cells richly chlorophyllose, *smooth, incrassate*. Capsule usually with a *narrower* mouth.

Hab. Walls, fallow fields, etc.; frequent. The var. β on sea shores, rare. Fr. winter.

In its typical form a markedly different plant from *P. truncatula*, but the above characters are not always pronounced, and the revolute margins and papillose leaves are sometimes correlated with a very short, truncate capsule.

The papillosity of the leaves does not, indeed, seem to afford a very stable specific character in this genus. The lid is occasionally slightly adherent to the columella.

It frequently grows with *P. lanceolata*, but I have never found any trouble in separating the two; apart from the peristome the latter has narrower, more regularly cylindrical, dark red or purplish capsules, thick-walled, narrowed at the mouth, with a regularly conical lid, obtuse, and of variable length; the present plant has the ripe capsules always paler brown, broader, more or less wide-mouthed (except at times in var. β), with the lid as in *P. truncatula*, wide and flat at the base, with a narrow and oblique rostellate beak. In addition to this, the spores in *P. intermedia* are much larger, being double the diameter of those of *P. lanceolata*, and the areolation also, as Braithwaite points out, is larger than in that species. It is difficult therefore to see why Schimper unites the present plant with *P. lanceolata* rather than with *P. truncatula*. I have not seen any specimens that would bear out the supposition, but it is difficult to resist the conclusion that there are probably two plants confused under this name, the more so as Boulay, who follows Schimper on this point, and whose care and accuracy of observation are noticeable throughout his work, distinctly attributes to it almost all the characters I have above enumerated as distinguishing *P. lanceolata*.

In deference to some of my correspondents, I have admitted *P. littoralis*, though only as a variety. Its colour and habit give it a distinct appearance, at least in its well-marked forms, but I find a great want of constancy in its characters. Sussex specimens with the colour, slightly incrassate cells, and narrow-mouthed capsule have the leaves scarcely differing in form from those of ordinary *P. intermedia*. On the other hand specimens which Mr. Wheldon sends from the Lancashire coast, very characteristic in habit, colour and leaf form, have the capsules quite as wide-mouthed as in *P. intermedia*, with none of the appearance which has caused this variety to be subordinated by some authors to *P. lanceolata*. M. Corbière also (cf. Husnot, Muscol. Gall., p. 433) has found the distinguishing characters disappear in proportion to its distance from the sea.

5. **Pottia crinita** Wils. (Tab. XXIII. B.).

In dense tufts, bright or pale green. Leaves *octofarious, broadly oblong-spathulate, obtuse;* margin recurved, nerve excurrent *in a long yellowish arista, ⅓ length of leaf;* upper cells quadrate-hexagonal, *lax*, 18–22 μ in diameter, papillose, *distinct;* margin at apex crenulate with papillae. Calyptra *smooth* (rarely slightly papillose). Capsule oval-oblong, with a short, rather distinct neck, reddish brown, *rather wide-mouthed* when empty; lid obliquely rostellate; spores 24–28 μ, densely and very minutely granulated; peristome none. Paroicous, antheridia naked in the axils of the upper leaves.

HAB. Sea coasts, on rocks and banks; here and there on various parts of the coast, not unfrequent in the south. Fr. winter.

Distinguished by its smooth calyptra and broad obtuse octofarious papillose leaves from all but *P. viridifolia*, from which it is known by the long hair-point. Mr. Nicholson finds a form in West Sussex with a much shorter hair-point, thus connecting the two; and I have had an almost identical plant sent me from Wales.

*** Pottia viridifolia** Mitt. (Tab. XXIII. D.).

Close to *P. crinita*, and scarcely differing except in the *bright deep green* colour, the leaves highly chlorophyllose and somewhat succulent in texture, and the nerve excurrent in a short point only.

HAB. Ledges of rocks, etc., near the sea; rare. Fr. winter.

Best perhaps subordinated to *P. crinita*, from which it scarcely differs except in a certain marked colour and texture difficult to define, and in the shortly excurrent nerve; and even this latter character loses in value in view of the plants referred to above. It must be admitted that some species of this group of Pottia rest on rather slender foundation, and several of the characters chiefly relied upon tend to weaken upon close scrutiny.

The broader, more obtuse leaves and their octofarious arrangement serve to separate this plant from *P. intermedia*, the colour also assisting in distinguishing it in the field. It differs from *P. asperula* and *P. Wilsoni* in the smooth calyptra and less highly papillose leaves.

6. Pottia Wilsoni B. & S. (*Gymnostomum Wilsoni* Hook.) (Tab. XXIII. C.).

Resembling *P. crinita*, but differing in the hair-point being *shorter, rather cuspidate than piliferous*, the upper cells *much smaller*, 12–18 μ, and *very obscure* with chlorophyll and numerous papillae, the calyptra *rough*, the capsule *oblong-cylindric*, slightly longer and narrower, with a distinct neck, and *not wide at the mouth*, slightly plicate when dry; a rudimentary peristome is usually to be observed after the fall of the lid. Spores slightly smaller, 18–22 μ.

HAB. Sandy ground, most frequently near the sea. Not common. Fr. winter.

The narrow, elongate capsule is a character relied upon by some authors to distinguish this plant in the field; but I venture to doubt its reliability as a test character. The points which separate *P. asperula* on the one hand and *P. crinita* on the other are also none too well defined, although as a rule the rough calyptra and the dense obscure upper areolation may be relied upon. A form or variety with the leaves piliferous from the longly excurrent nerve occurs in Cornwall and elsewhere. The rough calyptra and the very opaque upper areolation will, under the microscope, usually separate it from all the allied species except *P. asperula*, which is indeed hardly to be recognised except by the quinquefarious leaves, and the rather smaller and shorter capsule.

*** Pottia asperula** Mitt. (Tab. XXIII. E.).

Very close to *P. Wilsoni;* rather shorter, with the leaves obtuse or slightly acuminate, *quinquefarious*, the upper cells *larger*, the capsule rather smaller, shorter, *elliptical* rather than oblong, sometimes wide-mouthed and slightly turbinate when empty.

HAB. Cliffs, etc., near the sea. Rare. Fr. winter.

In specimens gathered near Penzance by Curnow I find the capsule exceedingly variable in size and form, sometimes being elliptical and narrow-mouthed, at others truncate, wide-mouthed, and exactly resembling that of *P. truncatula*, with which indeed the plants are associated, and from which they are quite inseparable as far as the capsules go, though very different in the leaves and calyptra. The lid, too, in the above specimens is frequently straight and subulate, not obliquely rostellate and acute as is usually the case with this species, according to Braithwaite's description. On the whole it is an unsatisfactory plant, even considered as a sub-species.

7. Pottia minutula Fuernr. (*Gymnostomum minutulum* Schleich. ; *P. Starkei* var. *Davallii* Lindb., Braithw. Br. M. Fl.) (Tab. XXIII. F.).

Very small, gregarious, reddish, resembling small forms of *P. Starkeana*. Leaves spreading and recurved, short and broad, *ovate, acute*, cuspidate with the shortly excurrent reddish nerve ; margin *recurved ;* upper cells *rather small*, 15–18 μ, incrassate, densely and minutely papillose. Seta very short, straight ; capsule *minute, shortly oval, rather wide-mouthed when empty*, dark brown, shining ; lid short, obtuse, conical, or mamillate ; calyptra *rough ; spores finely but strongly papillose*, variable in size, 25–35 μ. Peristome none, or quite rudimentary.

HAB. Fallow fields, etc. Frequent. Fr. winter.

United by Braithwaite, following Lindberg, with *P. Starkeana*, but sufficiently distinct, I think, as Venturi has pointed out (*Rev. Bry.*, 1885, p. 51), in the spores, which in the present plant are finely punctate with acute papillae, as is usual in this genus, but in that are coarsely tuberculate, and in most cases smaller. The capsule also, here, is usually shorter and more urceolate, being sometimes slightly contracted below the mouth after the fall of the lid. According to Venturi, the var. *conica*, usually attached to the present plant, properly belongs, for the same reasons, to *P. Starkeana ;* but specimens of that var. from the herbarium of G. H. K. Thwaites, which I have no doubt are genuine, have the spores with the fine, acute papillae of *P. minutula*, and I have little doubt that Wilson is quite right in considering both species to possess analogous varieties, which are, as he says, very difficult to separate, but which may be known by the difference in their spores. They do not, however, appear to be of great importance.

P. minutula and its sub-species *commutata* will hardly be mistaken for any other species except *P. Starkeana*, on account of their minute size ; the leaf form and structure will at once separate *P. truncatula*. It is most like *P. recta*, but the deciduous lid and wide-mouthed capsule at once distinguish the present plant. *P. Starkeana* has the capsule less wide-mouthed and the peristome distinct, but in view of *P. commutata*, it is scarcely safe to rely upon these characters without microscopical examination.

*** Pottia commutata** Limpr. (Tab. XXIII. H.).

Differs from *P. minutula* on the smaller size, the seta *flexuose and curved*, most markedly when dry, and especially at summit, so that the capsule is *usually inclined*, the mouth of the capsule

scarcely widened, sometimes slightly contracted; peristome *well developed*, variable, but in its best developed forms 100–180 μ in height, pale orange brown; teeth from a distinct basal membrane broadly linear, obtuse, *of 2–4, rarely 5, articulations, densely and highly papillose*. The upper cells of the leaves are usually somewhat smaller, 8–13 μ, and the lid with a slightly longer beak, but these characters are inconstant.

HAB. On the ground; chiefly near the sea. Very rare. Seaford and near Newhaven, Sussex, 1903 (*W. E. Nicholson*); Marazion, Cornwall, 1897 (*Cocks*).

I should, perhaps, have scarcely considered *P. commutata* deserving of more than varietal rank on the basis of Limpricht's description and figures alone. The Sussex plant, however, confirms his view by its well-marked characters. The curved seta and the highly developed peristome give the plant such an altered character that with the lens, or, indeed, with the naked eye, it is abundantly distinct from *P. minutula*, which according to Mr. Nicholson, may be recognised at once, even when growing with *P. commutata*, by the larger size and straight erect setae. The peristome is quite conspicuous and in its highest development quite equal to that of *P. Starkeana*; more developed, indeed, in the Seaford plants than in the form described and figured by Limpricht. I do not think it is possible to refuse a higher rank than that of a mere variety to this plant. At the same time its connection with *P. minutula* is undoubted. The curvature of the seta is not always well defined, while the presence of a rudimentary peristome in some forms at least of *P. minutula* is an added reason for considering the two plants nearly allied. I can find no reliable distinction in either the size or the sculpturing of the spores.

In some ways *P. commutata* may be considered to be intermediate between *P. minutula* and *P. Starkeana*, the peristome and the narrow-mouthed capsule connecting it with the latter; recourse should be had to the microscope in all cases, when the character of the spores will determine the identity.

8. Pottia Starkeana C.M. (*Weisia Starkeana* Hedw.) (Tab. XXIII. G.).

Very small, crowded, pale green. Stem very short, leaves oblong-lanceolate or very broadly ovate, variable in form, *short, acute, margin strongly revolute*, nerve reddish, excurrent in a cuspidate point; cells above *rather small*, 10–15 μ, rounded-hexagonal, rather incrassate, obscure, minutely and densely papillose. *Perichaetial bracts hardly distinct*. Seta short, capsule *small, oval or shortly oblong*, dark brown, shining, *not wide-mouthed*; calyptra *rough*; lid conical, obtuse or pointed. *Peristome teeth variable, more or less truncate and imperfect*, of 2–4 articulations, linear, flat, papillose, yellowish. Paroicous. *Spores coarsely and obtusely tuberculate.*

Var. β. *brachyodus* Wils. (Var. β. *affinis* Braithw., Br. M. Fl.). Peristome teeth *very short, truncate.*

HAB. Fallow fields and bare ground; not common. The var. β less frequent. Fr. winter and early spring.

Although this is probably distinct from *P. minutula* and its sub-species, the points of difference are not numerous ; the capsule is usually more or less narrowed at the mouth, or the mouth may be equal in width to the rest of the capsule, which, however, is not urceolate, nor truncate as it sometimes is in *P. minutula*. The peristome is always present, though sometimes very rudimentary ; and the spores, "resembling in miniature bags filled with apples" as Venturi describes them, and translucent instead of being rendered opaque, as in the other species, by densely crowded minute papillae, afford a good and easily observed distinction from those and indeed from all the species.

9. Pottia caespitosa C.M. (*Weisia caespitosa* Bruch) (Tab. XXIII. I.).

In small tufts, short, bright yellowish green, stems usually branched at the base. Leaves small, ovate or oblong-lanceolate, acute, *margin plane*, nerve excurrent in a *very short* green mucro ; cells above *very small*, incrassate, irregularly hexagonal, rough at the back with dense, obtuse papillae. *Perichaetial bracts distinct*, erect and sheathing. Seta *pale yellow ;* calyptra *smooth ;* capsule small, *ovate*, often slightly unequal, broad and rounded at base, *narrowed at the mouth* with a rather long oblique lid ; *peristome teeth small, narrow*, entire or slightly cleft, imperfect ; *spores minutely papillose*. Autoicous.

HAB. Chalky fields ; very rare. Sussex ; Kent ; Surrey ; Herefordshire. Fr. spring.

Easily distinguished from *P. Starkeana* by the smooth calyptra and plane-margined leaves ; from *P. lanceolata* by the yellow seta, plane margins, and smaller capsules ; from the other lowland species by the presence of a peristome ; the leaves, too, are unlike those of any of the allied plants.

10. Pottia lanceolata C.M. (*Leersia lanceolata* Hedw. (Tab. XXIII. J.).

Bright green, in dense tufts, rather tall. Leaves variable, quinquefarious or rarely octofarious, from oblong-lanceolate to obovate, *acute*, nerve rather broad in the upper part of the leaf, excurrent in a longer or shorter point, *margin revolute*, cells in the upper part *moderately large*, incrassate, densely papillose or almost smooth at back. Seta yellow when young, *orange red* when ripe ; capsule *narrowly elliptical, dark reddish brown, thick-walled, narrowed at the mouth ;* calyptra *smooth*, lid rather long, oblique, or short and conical ; *peristome teeth long, narrow*, of 8–10 articulations, erecto-patent or spreading when ripe, reddish or pale, with a line down the middle and usually slightly cleft at apex, sometimes perforate along the median line ; *spores finely granulated*. Autoicous.

HAB. Dry banks, wall tops, etc. Frequent. Fr. spring.

P. lanceolata is readily known by its highly developed peristome and narrow, elongate, dark purplish capsules. The peristome teeth are sometimes pale, and frequently become whitish after maturity. The nerve is slightly but distinctly thickened towards the apex of the leaf, and not unfrequently produces granular outgrowths on its surface in that part. It is in some respects a variable plant, but the variations as a rule are not such as to give rise to difficulty in identifying it; a form however, occurs with papillose calyptra (*f. scabra* Limpr.) which renders the plant when immature very liable to be mistaken for other species, such as *P. Wilsoni*. It occurs on the south coast, and I have gathered it in Northamptonshire. There is a tendency for this scabrous calyptra to be accompanied by octofarious, broader, spathulate leaves, but these characters are not clearly enough correlated to justify the foundation of a variety; I have gathered the plant with papillose calyptra but otherwise typical, and on the other hand I have collected in Bedfordshire a form with the leaves octofarious but not spathulate, and with the calyptra almost or quite smooth (cf. also Corbière, Rev. Bry., 1895, p. 34).

In the leaf *P. lanceolata* much resembles *Tortula atrovirens*, but that has a still greater development of nerve, the leaves are narrower, the nerve only very shortly excurrent, and the capsule more truncate and otherwise differing.

11. **Pottia latifolia** C.M. (*Weisia latifolia* Schwaeg.) (Tab. XXIII. K.).

Plants very short, *bulbiform*, gregarious or clustered, shining, pale green or whitish; leaves *imbricated, broadly obovate or orbicular, very concave, thin, rounded at top or the upper ones very slightly and obtusely apiculate*, margin plane or incurved, nerve narrow, *ceasing just below the summit*; cells in lower half of leaf lax, rectangular, hyaline or chlorophyllose, above becoming smaller, *regularly rhomboid*, with thin walls, or incrassate, the uppermost often decolorate. Seta orange, capsule oblong, smooth, dark brown, lid rather long, oblique, calyptra *smooth*; peristome teeth *lanceolate*, irregularly divided above. Autoicous.

Hab. Crevices of mountain rocks; very rare. On several mountains in Scotland; Castleton (Aberdeenshire ?). Fr. summer.

This very distinct and interesting species is totally unlike the other species of Pottia in its vegetative characters, but the fruit is quite that of the genus. The var. *pilifera* Schp. (*Bryum piliferum* Dicks.) has the nerve excurrent in a long flexuose arista, and was recorded by Dickson from Aberfeldy; according to Braithwaite, however, the herbarium specimens so named turn out to be *Tortula systylia* (*Desmatodon systylius* B. & S.), and the variety cannot therefore be considered as British, even were there no doubt as to the origin of the specimens in question.

40. **TORTULA** Hedw. (*emend. Lindb.*).

Plants variable in size, simple or branched. Leaves *more or less oblong in outline*, rarely narrower and often wider in the upper part than at base, *usually wide and obtuse at apex* with the nerve conspicuously excurrent; mostly yellowish green. Upper

cells, as a rule, opaque and chlorophyllose. Calyptra cucullate. Capsule erect, on a usually *long* seta, oblong or cylindric, rarely oval, gymnostomous or with a peristome of 32 *filiform teeth, united at base into a tubular membrane of varying length, above* free, straight or spirally twisted, distantly articulated, papillose. Spores mostly small (except in Pterygoneuron and some species of Desmatodon).

Like the majority of the Tortulaceae, the greater number of the species of this genus are terrestrial rather than rupestral, a few being arboreal. The difference between Tortula and Barbula is rather one of habit and general outline than of well-defined structural detail; nevertheless the various species separate themselves very naturally into the two genera, and a very slight acquaintance with the plants will enable the student readily to determine to which of the two any given plant must be referred.

DERIV.—Diminutive from Latin *tortus*, twisted; from the form of the peristome.

The British species of this genus fall readily into four Sections; and as the characters of these, besides being of importance for classification, lend themselves to the identification of the species, they are tabulated here for convenience.

A. PTERYGONEURON. Stems short. Leaves piliferous. Nerve producing one or two pairs of vertical lamellae on its ventral surface. Peristome wanting or imperfect.

B. ALOINA. Stems short. Leaves obtuse, rarely mucronate, concave with the margins strongly involute. Nerve very broad, producing abundant granulose threads on its ventral surface. Peristome teeth on a very short basal membrane.

C. DESMATODON. Short, rarely taller. Leaves soft, ovate, oblong or spathulate; nerve without distinct appendages. Peristome teeth from a distinct but rarely elongated basal membrane.

D. SYNTRICHIA. Usually robust and tall. Leaves large, oblong or spathulate, frequently aristate with the narrow excurrent nerve. Peristome teeth united at base in a long, spirally tessellated tube.

1 { Nerve with two or four broad lamellae above.....2
  { Nerve without lamellae, with or without granules or filaments.....3

2 { Capsule oval; seta short; cells of lid in straight lines.....*1. pusilla*
  { Capsule cylindric; cells of lid in spiral lines.....*2. lamellata*

3 { Nerve indistinct, broad, hidden above by granular filaments.....4
  { Nerve distinct throughout.....7

4 { Synoicous; capsule elliptic; ls. very short and obtuse.....*3. brevirostris*
  { Dioicous; leaves longer and narrower.....5

5 { Capsule oblique; ls. acuminate; spores about 25 μ.....*6. aloides*
  { Capsule erect; ls. usually obtuse; spores 15 μ.....6

6 { Capsule more or less elliptic, half covered by calyptra.....*4. rigida*
Capsule cylindric, calyptra covering lid only ; ls. incurved at tip
5. ambigua

7 { Ls. more or less distinctly bordered with long, narrow cells.....8
Leaves without such border.....11

8 { Capsule erect, or suberect.....9
Capsule cernuous, oval-oblong.....*7. cernua*

9 { Leaves short, under 1½ line long ; peristome teeth free.....*12. marginata*
Leaves 2-3 lines long ; peristome partly tubular.....10

10 { Usually short ; ls. oblong, scarcely tapering, border variable...*15. subulata*
Taller and slender ; ls. narrower, tapering, border distinct to apex
15. angustata*

11 { Nerve widened in upper half of leaf, excurrent in a mucro.....*9. atrovirens*
Nerve not wider above than below.....12

12 { Leaves very wide, soft, smooth at back and margin.....*10. cuneifolia*
Leaves distinctly papillose.....13

13 { Leaves very obtuse, nerve not (or minutely) excurrent.....*16. mutica*
Nerve distinctly excurrent in a cusp or hair-point.....14

14 { Ls. ovate-lanceolate, denticulate at apex ; peristome not twisted
8. suberecta
Ls. oblong or obovate, entire (except *ruraliformis*) ; peristome twisted.15

15 { Leaves with spinulose hair-points.....16
Hair-points (or cusps) smooth or nearly so.....20

16 { Leaves squarrose, with recurved margin (cells 10-12 μ).....17
Leaves erecto-patent, margin plane or nearly so above.....19

17 { Leaves obtuse, green at apex (except the nerve).....*19. ruralis*
Ls. narrowed to a hyaline acute apex, confluent with the nerve.....18

18 { Arista hyaline, strongly dentate.....*19*. ruraliformis*
Arista red, almost entire.....*19*. norvegica*

19 { Cells small, 6-7 μ, obscure ; dioicous.....*18. intermedia*
Cells 10-12 μ, clear ; plant tall .....*20. princeps*

20 { Leaves very concave ; nerve gemmiferous above.....*21. papillosa*
Nerve not gemmiferous.....21

21 { Leaf-margin strongly revolute almost to apex ; peristome teeth free
13. muralis
Margin plane above, or slightly revolute only.....22

22 { Peristome teeth free ; hair-points shortish.....*11. Vahliana*
Peristome partly tubular ; hair-points long.....23

23 { Plant very small ; seta short ; capsule elliptic.....*14. canescens*
Plant robust ; seta long ; capsule cylindric.....*17. laevipila*

A. PTERYGONEURON.

1. Tortula pusilla Mitt. (*Bryum pusillum* Hedw. ; *Pottia cavifolia* Ehrh., Schp. Syn.) (Tab. XXIII. L.).

Plants very short, densely tufted, *bulbiform*. Leaves more or less erect and imbricated, *small*, broadly oblong or obovate, *very concave*, obtuse or slightly pointed, cucullate at apex, margin

slightly incurved; *nerve excurrent in a short mucro or a long hyaline, terete, entire arista*, bearing on the face of the leaf, near the summit, one or two oval sacs, containing chlorophyllose granules, and finally splitting longitudinally so to form 2 or 4 lamellae, as in Catharinea, but shorter. Cells in the lower part of the leaf rectangular, rather short (3–5 times as long as broad), with firm walls, the upper smaller, rounded-quadrate, slightly papillose. Seta red, *short, 1–2 lines, capsule small, oval or elliptic*, dark reddish brown, glossy, somewhat plicate or rugose when empty, *gymnostomous;* lid obliquely rostellate, *cells in straight rows*. Autoicous.

Var. *β. incana* N. and H. In dense *hoary* tufts. Leaves with *very long* hair-points; capsule *on a very short seta, hardly exserted*, shortly oval.

HAB. Walls and banks. Locally abundant. The var. *β* rare. Fr. winter.

A very distinct plant, not to be confounded with any but the next species; indeed, were it not for its close affinity to that, it would undoubtedly be best placed, as has usually been done, under Pottia. It is very variable in the length of the hair-point (which is indeed sometimes almost obsolete), and of the seta, and intermediate forms may frequently be observed between the type and the var. *incana*.

The present species forms larger or smaller low patches or tufts usually producing abundant capsules, which by their deep purplish brown colour and large numbers give a very characteristic tint to the plant; in the next species the longer seta and paler fruit give a much lighter hue to the patches, and the two are as a rule distinguishable from one another by this, even at some distance, when the fruit is mature.

The Rev. C. H. Binstead has sent me a very remarkable form from Breinton, Herefordshire, with the arista of the leaves rough. This is usually given as a character distinguishing a continental moss, *Pharomitrium subsessile* Schp. from *T. pusilla*. A single old capsule on Mr. Binstead's plant shows it to belong here, but it is a very unusual form. The Pharomitrium should be looked for with us; besides the rough hair-point it has the capsule immersed and almost sessile. The Herefordshire plant may be the var. *Perraldieri* Besch. (cf. Journ. of Bot., June, 1899), but it requires further investigation.

2. Tortula lamellata Lindb. (*Barbula cavifolia* Schp., Syn.) (Tab. XXIV. A.).

Very near the last species, and, indeed, indistinguishable except by the fruiting characters (the hair point, however, is perhaps never so long as it is sometimes found in that plant). *Seta longer, 2–4 lines;* capsule narrower and longer, *oblong or cylindrical*, sometimes slightly curved, brown, less glossy, furrowed when dry; calyptra larger; *lid with the cells spirally arranged. Peristome present*, but very fragile and always falling away with the lid, *teeth very slender*, slightly twisted, united at the base by transverse bars.

HAB. Mud-capped walls and bare ground. Not common. Fr. winter, a little later than *T. pusilla*.

The tall seta, narrower paler capsule, and constant presence of a peristome, albeit a very imperfect one, are the chief characters separating this from the last species. I have found it in several localities in Northamptonshire on the mud caps of walls usually growing in company with *T. pusilla*, and quite different in appearance. A single plant may here and there present an intermediate form, but in the vast majority of cases the two plants are perfectly distinct, the present having quite the appearance of a Tortula, while the habit of the other is rather that of a Pottia.

It is impossible to view the peristome apart from the lid, and the best way to observe it is to look at it through the lid of a just ripening capsule, or it may be in part detached by crushing the lid under a cover glass.

B. ALOINA.

3. Tortula brevirostris Hook. & Grev. (*Barbula brevirostris* B. & S., Schp. Syn.) (Tab. XXIV. B.).

Plants very short, gemmiform, gregarious in small clusters, pale green or reddish brown. Leaves all *small, very concave and obtuse*, the lowest roundish, very short, the upper oblong, margin inflexed, cucullate at apex, erecto-patent; *nerve rather thin*, not excurrent, lower cells rectangular, or rectangular-hexagonal, hyaline, thin-walled, large, the upper quadrate, or vertically compressed, so as to be transversely oblong or elliptical, very incrassate, brownish-yellow, pellucid. Seta short, *2–3 lines long*; capsule small, narrowly elliptical; annulus broad, separating; *lid short*, obliquely rostellate, *about* $\frac{1}{3}$ *length of capsule*; peristome forming a single spiral, short. Spores small, about 15 μ in diameter. *Synoicous.*

HAB. On mud-capped walls in limestone districts. Very rare. Edinburgh; Buxton; Yorkshire. Fr. late autumn.

Very near *T. rigida* in appearance, but smaller with shorter seta and lid, and the leaves even shorter and more rounded; the fruit also appears to ripen a little earlier, and the synoicous inflorescence is a marked character of distinction. I have, indeed, specimens of *T. rigida* with the capsule so small and the lid so short as to render them quite inseparable from the present species except by the inflorescence; and on the other hand Prof. Barker has gathered plants near Buxton with most of the characters of *T. rigida*, but synoicous. Such forms, however, are rare. As in all the species of the section Aloina, the leaves soon turn a purplish brown. The granular filaments on the nerve, as is the case with the lamellae of *Polytrichum*, give the leaves in this and the allied species a solid appearance.

4. Tortula rigida Schrad. (*Barbula rigida* Schultz, Schp. Syn.; *Tortula stellata* Lindb., Braith. Br. M. Fl.) (Tab. XXIV. D.).

Very small, but slightly larger than the last, in wider, brownish patches. Leaves similar, but the upper rather larger, *longer, and*

narrower at the summit, more spreading : nerve thick, vanishing at apex, or, rarely, running out into a mucro or longer hair. Seta *longer, 3–5 lines*, deep or brownish red ; capsule erect, narrowly elliptical or shortly cylindrical, larger than in the last, *lid longer, usually fully half the length of the capsule*, rostrate, straight or slightly curved ; *calyptra covering* $\frac{1}{3}$–$\frac{1}{2}$ *capsule*. Annulus *broad, separating ;* peristome longer, forming $1\frac{1}{2}$ turns of a spiral ; spores as in that species. *Dioicous ;* male plants minute.

HAB. Mud caps of walls in limestone districts. Not common. Fr. winter.

T. rigida is except in rare cases recognisable without much difficulty from the last by the larger capsule with longer lid, and the dioicous inflorescence will (except in very rare instances) determine it ; *T. ambigua* has the capsules distinctly longer, larger, and of a rather different texture, the peristome shorter, the annulus persistent, and the calyptra hardly reaching below the lid ; the leaves are usually narrower and less obtuse than in the present plant, but not constantly so.

Although the specific name *rigida* has, as Braithwaite says, been applied at one time or another to all the four species of this section, its use has been restricted to the present plant for more than a century, and its retention can hardly lead to confusion at the present day.

5. Tortula ambigua Ångstr. (*Barbula ambigua* B. & S., Schp. Syn. ; *Tortula ericaefolia* Lindb., Braithw. Br. M. Fl.) (Tab. XXIV. E.).

Larger than the last in leaves and fruit ; in dense patches. Leaves *longer, lingulate, incurved and cucullate* at apex and usually appearing obtuse, but slightly pointed when flattened out, spreading, slightly curled when dry, smooth at back. Seta red, paler above ; capsule *erect, elongate-cylindrical*, dark brown, of rather thicker texture ; lid elongate ; annulus *narrow, persistent ; calyptra hardly reaching below the lid ;* peristome less strongly contorted ; spores as in *T. brevirostris*. Dioicous.

HAB. Mud-capped walls and banks in calcareous districts. Not uncommon and locally abundant. Fr. winter.

The capsules in this species are distinctly cylindrical, not elliptic as sometimes in the last, and the shorter calyptra will also serve to distinguish it. From the next it differs in the erect capsules and the less acute leaves, which, though variable in this respect, are rarely so short and obtuse as in *T. rigida*, and never so distinctly acute as in typical *T. aloides*.

It however is not without its difficulties. Mr. Jas. Murray has sent me from two localities in Scotland specimens which have the larger, inclined capsule of *T. aloides*, and the longer, narrower leaves, and are scarcely to be recognised as *T. ambigua* but by the somewhat cucullate leaf apex and the smaller spores. The leaves in *T. ambigua* also are occasionally distinctly mucronate at apex, but perhaps never so narrowly acute.

6. Tortula aloides De Not. (*Trichostomum aloides* Koch; *Barbula aloides* Fuernr., Schp. Syn.) (Tab. XXIV. C.).

Resembling *T. ambigua*, but with the leaves distinctly longer, *narrowed above and acute, not cucullate at apex*, mucronate with the excurrent nerve. Seta bent just below the neck of the capsule, which is therefore *inclined*. Calyptra reaching a little below the lid ; capsule rather larger, cylindric, slightly curved or swollen on one side ; peristome teeth once twisted, convergent above when dry ; *spores larger*, 20–25 μ in diameter. Annulus narrow, persistent. Dioicous.

HAB. Calcareous banks and wall tops. Not uncommon. Fr. winter.

Generally to be known by the narrowed, acute leaves, and the longer inclined capsule. The peristome teeth show considerable variation both in length and direction.

C. DESMATODON.

7. Tortula cernua Lindb. (*Desmatodon cernuus* B. & S., Schp. Syn. et plur. auct.) (Tab. XXIV. F.).

In broad low patches, bright green ; stems short. Leaves erecto-patent, slightly twisted when dry, ovate-lanceolate or subspathulate, *acute or shortly acuminate*, finely crenulate-denticulate above, margin plane or recurved in lower half, *distinctly bordered to above the middle with several rows of narrow, incrassate cells ;* one or two rows at margin in lower half of leaf *in two or three layers*. Nerve reddish, excurrent in a cuspidate point. Upper cells hexagonal-rhomboid or rounded, 16–20 μ, each with several scattered papillae, narrower towards margin, lower very lax, rectangular, hyaline. Seta red, shining, capsule *cernuous or horizontal, shortly and turgidly oval, gibbous*, narrowed at mouth, reddish brown, glossy ; lid short, rostellate, curved upwards or downwards. Peristome teeth erect or faintly twisted, red, converging above. Spores *large*, 30–40 μ, papillose. Autoicous.

HAB. Very rare ; at foot of wall, Aberford, West Yorkshire, 1900 (*G. Webster*) ; and two other localities in Yorkshire. Fr. late summer.

A species at once recognised by its short, rounded, horizontal capsule, quite different from any other of our British species ; resembling that of *Swartzia inclinata* quite closely, but of course entirely distinct in the leaves. The spores are larger than in any other species of the genus. The capsule varies considerably in size, in the same tuft. *T. suberecta* differs, apart from the fruit, in the much smaller leaf cells and different border.

T. cernua is widely distributed in the northern and alpine regions of the continent, and it seems strange that its only station with us should be at the low altitude of the plain of Central Yorkshire. It has however recently been found at an equally low altitude in Belgium.

8. Tortula suberecta Drumm. (*Desmatodon obliquus* B. & S., Schp. Syn. et plur. auct.) (Tab. XXIV. G.).

Short, tufted or gregarious, dull or yellowish green. Leaves erecto-patent, slightly crisped when dry, thin, concave, ovate-oblong or ovate-lanceolate, *acute or acuminate ;* margin revolute to near apex, *entire or faintly denticulate above ;* nerve excurrent in *a rather long yellowish hair ;* cells above small, 10-16 μ, hexagonal, obscure, papillose, several rows at margin pellucid, rectangular, forming a paler border. Seta slender, capsule *usually inclined, sub-cylindric*, slightly curved or straight ; basal membrane rather long, teeth fragile, oblique, but hardly spirally twisted. Spores rather large, 18–24 μ, strongly papillose. Autoicous.

HAB. Alpine rocks. Very rare. Forfarshire. Fr. late summer.

T. suberecta is a rare species, closely allied to the common continental *Desmatodon latifolius* B. & S. It is curious that the latter should escape these shores while the much rarer plant is found here. I have had the opportunity of examining a Scotch specimen, gathered in Forfarshire in 1886, and there is no doubt of the identity of our plant with Drummond's North American type. The main difference between this and *D. latifolius* lies in the size of the upper cells, which in the latter are considerably larger ; the leaves too in *T. suberecta* are somewhat narrower in outline than in either that or *T. cernua*. Although the capsule is usually slightly inclined in the present plant, and erect in *D. latifolius*, the character is by no means a reliable one, both species varying in this respect, as is at once seen on looking through a series of the continental plants.

The marginal cells at mid-leaf are not bi-stratose, nor much elongated as in the last species.

T. systylia (*Desmatodon systylius* B. & S.) exists in some old herbaria labelled as *Pottia latifolia* var. *pilifera*, and purporting to have been gathered by Dickson near Aberfeldy. It is an alpine plant, found in Norway and Central Europe, and is hardly likely to have been found in the locality named. It differs from the present species in the erect capsule and entire leaves with almost plane margins, and smoother, scarcely papillose cells, from *T. atrovirens* in the longly excurrent nerve and plane borders.

9. Tortula atrovirens Lindb. (*Grimmia atrovirens* Sm. ; *Barbula atrovirens* Schp., Syn. ; *Desmatodon nervosus* B. & S., plur. auct.) (Tab. XXIV. H.).

Densely gregarious or tufted, short, dark green. Leaves spreading, *spirally twisted* and imbricated when dry, *oval-oblong or sub-spathulate*, broadly and shortly acute, concave ; *margin strongly revolute ;* nerve yellow, excurrent in a very short mucro, *much thickened in the upper part of the leaf*, sometimes granulose on the upper surface. Cells at base lax, thin-walled, hyaline, rectangular, the marginal rather shorter, above quadrate, at apex rounded-quadrate and *obscure, minutely papillose*. Seta *short*, reddish, 1½-3 lines in length, capsule *small*, short, oblong, exannulate ; lid obliquely rostellate, about half the length of the

capsule ; peristome teeth rather short, on a short but distinct basal membrane, somewhat irregular, oblique or very slightly twisted, more strongly so when moist. Spores 18-21 μ. Autoicous.

HAB. On earth and walls, usually near the sea. Not common. Fr. spring.

This species forms, in conjunction with one or two continental ones, another link, additional to the species of the section Pterygoneuron, between Pottia and Tortula. In the short capsule and seta, as well as in the leaf, it has much the appearance of a Pottia, especially coming near to *P. lanceolata*, but besides the points of difference noticed under that plant, the peristome is quite that of Tortula, and the cells of the lid shew a tendency to the spiral arrangement characteristic of the latter genus.

The thickened nerve and small leaves will readily distinguish it, even when barren, from any of its near allies.

The lower part of the stem is usually embedded in the soil on which it grows, leaving only the upper part free, and rendering the plant even shorter in appearance than it really is.

The var. *edentula* B. & S. has been found in the South-west counties of England. It is characterised by a very rudimentary peristome, sometimes reduced to the basal membrane ; but capsules in a single tuft will manifest much variation in this respect.

10. Tortula cuneifolia Roth (*Bryum cuneifolium* Dicks. ; *Barbula cuneifolia* Brid., Schp. Syn.) (Tab. XXIV. I.).

Gregarious or loosely tufted, *bright green*, very short. Upper leaves *large*, forming a terminal rosette, spreading, when dry slightly crisped and incurved, *but not spirally twisted, broadly obovate-spathulate*, short, acute, or slightly acuminate, rarely obtuse, concave or almost plane, *thin, soft ; margin plane ;* nerve *thin*, excurrent in a cuspidate point or a short mucro, occasionally in a rather short but distinctly flexuose hyaline hair-point, very rarely vanishing ; cells lax and hyaline at base, above large, 18-24 μ, *pellucid*, rounded-quadrate, thin-walled, two or three rows at margin more incrassate and usually more deeply coloured, forming a more or less distinct border to the leaf ; *all smooth at back and margin*. Seta *elongated, 4–8 lines long*, reddish, capsule narrowly oblong or cylindrical ; lid shortly rostellate, about $\frac{1}{3}$ length of capsule ; peristome teeth from a rather broad basal membrane, long, strongly twisted. Spores 15-18 μ. Autoicous.

HAB. Banks near the sea, rarely inland ; not uncommon on the south coast. Fr. spring.

The texture of this species is remarkably soft and delicate, and from its wide leaves with lax smooth areolation it cannot be taken for any other species of the genus. The leaves are frequently almost as broad as long, but are variable in form and degree of obtuseness. They are not unlike some of the broad-leaved species of Pottia, such as *P. Wilsoni* and *P. viridifolia*, but these are almost always smaller and narrower, and have papillose areolation and recurved margins.

11. Tortula Vahliana Wils. (*Barbula Vahliana* Schultz, Schp. Syn.) (Tab. XXIV. J.).

Stems short, *gregarious*, pale green; resembling *T. muralis* var. *aestiva*. Leaves patent, *soft*, erect and slightly twisted when dry, *oblong-lingulate*, obtuse or slightly acute, *thin;* margin *plane or here and there lightly recurved*, very rough with projecting double papillae; nerve thin, excurrent in a short point or long greenish arista; cells rectangular and hyaline at base, rounded-hexagonal above and *opaque with chlorophyll and papillae*, 1–2 rows at margin more pellucid, forming a faint border. Capsule longly and *narrowly* cylindrical on a dark red seta, slightly curved; lid shortly rostellate, $\frac{1}{3}$ length of capsule; annulus broad; peristome long, twisted, from a short but distinct basal membrane. Spores 12–15 μ. Autoicous.

Var. β. *subflaccida* Lindb. (*T. oblongifolia* Wils.). Smaller, *leaves shorter, more opaque*, margin plane, nerve shortly excurrent; capsule and lid *shorter*.

HAB. Banks, usually on clay soil; very rare. Surrey; Sussex; Cambridgeshire; Herefordshire; Ireland. The var. β near Dublin. Fr. spring.

Although very much resembling some forms of *T. muralis*, especially the var. *aestiva*, there is not likely to be much difficulty in identifying the present species, the habitat and mode of growth being quite different from the tufted or densely crowded, rupestral habit of that moss; the leaves, too, are broader and thinner, with the margin less strongly and regularly revolute, and the capsule more narrow and elongate. As in the last species, the leaves are subject to much variation in form, and the hair-point is variable in length. Like *T. cuneifolia* it is a southern, indeed a Mediterranean species.

12. Tortula marginata Spruce (*Barbula marginata* B. & S., Schp. Syn.) (Tab. XXV. A.).

Short, densely gregarious or in wide patches; pale or dark green above, brown below. Leaves erecto-patent, when dry very slightly twisted, *narrowly oblong or lingulate*, sub-acute, rarely obtuse; margin *plane, bordered with a distinct yellowish band of 2–4 rows of linear cells in two layers*, paler than the rest of the leaf, nerve excurrent in a *short green mucro;* upper cells small and dense, sub-quadrate, very opaque and obscure, papillose. Seta *bright orange red, slender;* capsule oblong-cylindric or shortly cylindric; lid about $\frac{1}{2}$ length of capsule; peristome on a short basal membrane. *Dioicous*.

HAB. Stones and walls, often on sandstone; not common. Fr. spring, but not confined to one season.

Usually more slender than *T. muralis*, in wide patches, not in small cushions; and distinct from all but the var. *aestiva* of that species in the short mucro; I have seen specimens of that variety, however, which could

certainly not be recognised except with the aid of the microscope, when the distinct, pale, yellowish border marks off *T. marginata* from all the allied species. The pale red, slender seta gives it a different appearance from ordinary forms of *T. muralis* and *T. Vahliana*.

13. Tortula muralis Hedw. (*Bryum murale* L. ; *Barbula muralis* Timm, Schp. Syn.) (Tab XXV. B.).

In its typical form growing in *small dense cushions*, sometimes in extended patches, short, in its tallest state rarely $\frac{1}{2}$-inch high ; dull or brighter green, *hoary*. Leaves patent, when dry twisted and curled, *oblong or elongate-lingulate*, obtuse ; *margin revolute, not thickened*, slightly yellowish ; nerve yellowish, excurrent in a *long hyaline smooth hair*, usually fully half the length of the leaf ; cells as in the last species, but without the marginal band. Capsule shortly and rather widely cylindric, on a *purple* seta ; lid rostellate ; peristome teeth from a *narrow* basal membrane, spirally twisted. Autoicous.

Var. β. *rupestris* Schultz. Robust, *tall*, more branched ; leaves *larger*, broader ; seta *very long*, sometimes one inch, capsule *longer*, cylindric.

Var. γ. *aestiva* Brid. *Short, densely gregarious in wider patches*, bright green ; leaves narrower, *linear*, nerve excurrent in a *green mucro* or very short hair ; seta and capsule shorter.

Hab. Walls and stones ; very common. The var. β on wet rocks, etc., rare. The var. γ on shady sandstone and calcareous rocks, not common. Fr. spring.

One of our commonest and in its typical form most distinct mosses. The var. *aestiva* is the only form that is at all likely to be mistaken for any other plant, *e.g. T. marginata ;* but the leaves are usually more twisted, the seta stouter and darker, and in any case the leaf margin offers a crucial distinction ; although sometimes very narrowly recurved, the double thickness renders it almost always darker and more opaque than the rest of the leaf, whereas in *T. marginata* the border is paler and more translucent, and its structure totally distinct.

As in some of the other species of this genus, two ot three marginal rows of cells are usually more pellucid and incrassate, and yellowish, thus forming a paler yellowish band ; but owing to the recurving of the margin, this character is only noticeable upon careful examination.

In very dry situations the tufts become very hoary with the elongated hair-points.

14. Tortula canescens Mont. (*Barbula canescens* Bruch, Schp. Syn.) (Tab. XXV. C.).

Resembling the last species, but *less pulvinate*, densely gregarious, bright green when moist, hoary only when dry. Leaves concave, rather shorter and wider, *margin less widely recurved* hair-point rather shorter. Seta shorter, capsule

smaller, oblong ; lid half the length of the capsule ; peristome *from a long tubular basal membrane*, forming a tessellated tube for almost half its length. Autoicous.

HAB. On earth, very rare ; South coast ; Wales ; Perthshire. Fr. spring.

Although the vegetative points of difference between this and the last species are of some value, it would hardly be safe to attempt to distinguish barren plants from *T. muralis* ; the difference in the tube of the peristome is the only obvious and of course an important difference. It is, however, a smaller plant in all its parts than the typical form of that species.

The pale yellowish border to the leaf, mentioned under *T. muralis*, is more marked in this plant owing to the margin being less recurved, and, indeed, sometimes almost plane.

The Clova locality recorded by Braithwaite and others was due to an error.

D. SYNTRICHIA.

15. Tortula subulata Hedw. (*Bryum subulatum* L. ; *Barbula subulata* P. Beauv., Schp. Syn.) (Tab. XXV. D.).

Stems loosely tufted or densely gregarious, *short*, rarely ½-inch in height, bright green. Leaves large, 2–3 lines long, erecto-patent or more widely spreading, when dry crisped and contorted, but hardly spirally twisted, with the yellowish margins and strongly prominent pale glossy nerve conspicuous ; *oblong-lanceolate or narrowly oblong-spathulate*, at apex rounded and shortly acute, or slightly tapering ; nerve stout, *excurrent in a longer or shorter mucro*, margin slightly but variably recurved, sometimes on one side only, or quite plane, *with a distinct yellow border of linear, often bistratose cells* reaching from the base to a variable height, sometimes to apex, but usually vanishing near the middle ; at apex *slightly denticulate*, irregularly crenulate, or almost entire ; cells of the lamina at base lax, hyaline, rectangular, narrower and yellow at margin, becoming chlorophyllose and smaller above, in upper part rounded or rounded-quadrate, rather variable in size, *obscure*, very chlorophyllose and finely papillose or almost smooth. Seta stout, ½–¾ inch long, reddish, strongly twisted and angular when dry ; capsule *large, very long* (frequently ¼-inch without the lid), cylindric, slightly curved, thick-walled ; lid rather obtusely rostrate, ⅓ length of capsule ; calyptra large, shining, golden brown ; peristome long, pink, the teeth united into a tube for about ⅔ their length. Autoicous.

Var. *β. subinermis* Wils. *Slender*, leaves rather short, of *soft texture*, faintly bordered, *very shortly mucronate*, capsule and seta *shorter*.

HAB. Sandy banks, common. The var. *β* on trees by water, etc., rare. Fr. summer .

Although several characters, as described above, are extremely variable, they are not such as are likely to give rise to any difficulty in identifying this plant, which is readily known both by its leaves and by its capsule, which is extremely long, especially when contrasted with the short stems. The cells are usually rather small and very obscure, but are occasionally larger and more pellucid. The narrow border of linear cells is frequently replaced in the upper part of the leaf by an often wider band of shorter cells almost like those of the rest of the lamina, but paler and more pellucid. For the characters which separate it from the sub-species *T. angustata* Wils. see below.

The var. *β* is well marked in its soft texture, short capsule, and almost muticous leaves.

* **Tortula angustata** Wils. (*Barb. subulata* var. *angustata* Schp. Syn.) (Tab. XXV. E.).

Very near *T. subulata*, but markedly differing in habit. *Taller and more slender*, ¼–1 inch high, dull green. Leaves *long, narrowed, tapering to a narrower, more acute point*, border thickened, cartilaginous, of narrow cells, *distinct to apex*, where it is more strongly toothed. Seta *more slender ;* capsule paler, *more slender and more arcuate ;* peristome paler, more slender ; lid rather longer and more acute.

Hab. High exposed banks ; rare. Fr. early summer.

Although the above characters are mostly comparative, the plant is very different from typical *T. subulata*, markedly so in the form of the fruit, and it certainly merits a higher rank than a mere variety ; still, it seems best to subordinate it to that species rather than to give it a separate specific position, especially as intermediate forms occur.

[**Tortula inermis** *Mont.* must be deleted from our list. Part of the original gathering from Cowie Moss was sent to me by Dr. Kidston, and proved to be *T. subulata* var. *subinermis*. The habitat, "On trees covered with mud from recurring overflowing of stream," would alone preclude *T. inermis*, and is characteristic of the var. *subinermis*. I have explained the mistake at more length in Journ. of Bot. 1921, p. 133].

16. Tortula mutica Lindb. (*Barbula latifolia* B. & S., Schp. Syn., et plur. auct.) (Tab. XXV. F.).

Dusky yellowish green, in smooth wide patches or smaller tufts, ½–1 inch high, slightly branched. Leaves larger and more crowded upwards, forming a terminal cup-shaped rosette, *soft*, when dry dull brown or blackish, flexuose and appressed ; *broadly spathulate from a narrow base, very obtuse and rounded at apex*, margin narrowly recurved in the lower half, plane and undulate above, with the marginal cells a little more obscure or discoloured, often eroded, rough with projecting papillae ; nerve stout,

brownish, *reaching apex or minutely excurrent*, or vanishing just below the summit. Basal cells lax, rectangular, the median hyaline, those near the margin usually chlorophyllose, in upper part of leaf very small, roundish, regular, in oblique rows, radiating from the nerve, obscure, finely papillose. Seta short, 2–3 lines long, capsule *small*, cylindrical, slightly curved; lid $\frac{1}{3}$–$\frac{1}{2}$ length of capsule; tube of peristome $\frac{1}{3}$ the whole length; annulus narrow. Dioicous.

HAB. Roots of trees by water. Not uncommon. Fr. very rare, early summer.

A very distinct species, usually growing in spots liable to flooding, and hence often embedded in mud. The fruit, so far as my experience goes, even when present is only sparingly produced. It somewhat resembles *Cinclidotus Brebissoni*; the differences are pointed out under that plant. *T. laevipila*, in addition to the hair-point, has the leaves narrower, less soft and flaccid, and almost always with some differentiation of the marginal cells in the upper part.

Gemmae are frequently found on the leaves.

17. Tortula laevipila Schwaeg. (*Syntrichia laevipila* Brid.; *Barbula laevipila* B. & S., Schp. Syn.) (Tab. XXV. G.).

In small or wide tufts, bright or deep green, reddish below, $\frac{1}{2}$–1 inch high; stems branched, radiculose below. Leaves *spreading*, the uppermost slightly recurved, when dry incurved and twisted, appressed to the stem or slightly spirally contorted, ovate or oblong, rounded and obtuse or emarginate at apex or very slightly acute-pointed; nerve strong, red, excurrent in a *long flexuose hyaline arista*, which is reddish at the base, *smooth or very faintly denticulate*, about half the length of the leaf; margin *narrowly recurved about the middle of the leaf*, almost plane above; upper cells small, hexagonal-rounded, *obscure*, papillose, the marginal similar, or nearly so, rough at edge with double papillae. Seta rather longer than in the last, 3–5 lines, capsule elongate-cylindric, narrow, slightly curved; lid and peristome as in the last. Autoicous.

Var. β. *laevipilaeformis* Limpr. (*T. laevipilaeformis* De Not.). Leaves scarcely recurved, oblong or *spathulate*, rounded or pointed, not emarginate at apex; hair-point shorter, margin *plane* or only very slightly recurved, in upper part of leaf *distinctly bordered* with 2–5 rows of larger, *incrassate*, *yellowish*, *smooth or scarcely papillose* cells. Gemmae occur in the centre of the rosette of comal leaves, in the form of minute modified apiculate leaves. Dioicous or autoicous.

HAB. Trunks of trees, common. The var. β probably frequent, but mostly in the south. Fr. summer.

T. ruralis differs in the taller stems, more recurved leaves without a distinct border, and dentate arista. *T. intermedia* in the rough arista, in the

colour browner and not so usually bright green, and in the terrestrial or rupestral, not arboreal habitat. After examining a number of plants of *T. laevipila* and *T. ruralis*, I am driven to the conclusion that the relative size of the cells affords no safe guide to their identification; in both the cells are somewhat variable in size. In *T. intermedia* they are smaller than in either of the other two species, and still more obscure.

The var. β was finally raised to specific rank by Limpricht. The border is well marked, and when treated with caustic potash comes out very distinctly and prettily. The foliose gemmae are not always present, however, and a modified border may not unfrequently be seen in plants that scarcely differ from the type in any other way; Mr. Nicholson finds plants, too, with abundant foliose gemmae, but with scarcely any leaf border. I prefer, therefore, to let it stand as a variety only. Its distribution is a southern one, and of the few British specimens I have seen all come from the more southern parts of England; it may, however, prove to have a much wider range when looked for.

18. Tortula intermedia Berk. (*Syntrichia intermedia* Brid.; *Barbula intermedia* Milde, Schp. Syn.; *Tortula montana* Lindb., Braithw. Br. M. Fl.) (Tab. XXV. H.).

Somewhat intermediate between *T. laevipila* and *T. ruralis*; robust, in large tufts, *dull brownish green or orange-brown, hoary* above, 1–1½ inches high. Leaves *crowded, erecto-patent, straight* or very slightly recurved, flat or somewhat concave, incurved and appressed when dry, the upper ones sometimes slightly spirally twisted, variable in size, but *usually smaller and shorter than in T. ruralis*, oblong-spathulate, very obtuse and even emarginate at apex, margin *less strongly recurved and only in the lower half*; cells *much smaller above*, 9–10 μ, *very dense and obscure, hardly distinct at margin*, which is verruculose, but less highly so than in *T. ruralis*; nerve strong, red, excurrent in a *less toothed*, hyaline *arista*. *Capsule shorter* than in that species, on a *shorter seta*; peristome also shorter. Dioicous.

HAB. Calcareous rocks and soil; frequent. Fr. early summer.

Differs from the last species, in addition to the characters there mentioned, in the taller stems, the dioicous inflorescence, and the absence of any distinct border in the upper part of the leaf. Forms of *T. ruralis*, when growing on walls or stony ground, frequently resemble it, but are in general easily recognised by the more or less squarrose leaves, the larger, more distinct cells, and more strongly recurved margin, as well as by the more strongly toothed arista.

When growing on the ground it is often of a rich golden brown colour.

19. Tortula ruralis Ehrh. (*Bryum rurale* L.; *Barbula ruralis* Hedw., Schp. Syn.) (Tab. XXVI. A.).

In loose, tall cushions, 1–3 inches high, *bright green above, bright reddish brown below*, robust; stems branched. Leaves *less crowded*, more so at the apex of the stems, *squarrose-recurved* especially above, when dry appressed and slightly twisted,

with two longitudinal plicae which are faint when moist but distinct when dry ; longly oblong-elliptical or oblong-spathulate, *concave-carinate*, at apex obtuse or emarginate, more rarely acute ; *margin reflexed almost to the summit ;* nerve reddish, muricate at back above, prominent behind, excurrent in a long, flexuose, *strongly spinulose arista* which is hyaline above, often reddish at base, sometimes equalling in length the rest of the leaf. Cells at mid-base lax, rectangular, hyaline, towards margins coloured, above rounded-hexagonal, 12–16 μ in diameter, strongly papillose, rather obscure, the walls frequently brown and incrassate ; marginal cells hardly distinct, strongly verruculose with coarse, bifid papillae. Seta long (about 1 inch) stout, reddish, capsule *narrowly cylindric*, slightly curved, *long ;* lid large, half as long as the capsule ; peristome very long, tubular in the lower half, pink. *Dioicous.*

HAB. Thatched roofs, stony ground, walls, etc. Common. Fr. early summer.

A very fine species, often covering the thatch of roofs, and then reaching its highest development ; when growing on the ground or on walls it is often shorter, of a golden or browner tint, with shorter, straighter leaves, in short with much the appearance of *T. intermedia ;* but I have not observed, in these forms, any corresponding approach to that species in leaf structure or in other distinguishing characters ; I am therefore inclined to allow *T. intermedia* full specific rank, though in the opinion of many continental botanists it does not deserve more than a subordinate position. With the following sub-species it is different ; the fruiting characters are the same as in *T. ruralis ;* the areolation presents no points of difference, and, moreover, intermediate forms may be observed.

T. ruralis rarely grows on trees, and is not likely, for that and other reasons, to be confounded with *T. laevipila ;* when arboreal however it is usually shorter and denser, and as the margin is occasionally also but slightly recurved, care must be taken in distinguishing the two in such cases. *T. princeps* is synoicous, and has the leaves erecto-patent, not recurved.

* **Tortula ruraliformis** Dixon (*Barbula ruraliformis* Besch. ; *T. ruralis* var. *arenicola* Braithw., Br. M. Fl.) (Tab. XXVI. B.).

Differs from *T. ruralis* in the colour, *golden brown* or reddish, very rarely green above, in the leaves somewhat *narrowed above and at apex acute with the lamina running out into a hyaline dentate point* becoming confluent with the excurrent nerve. Perichaetial bracts broader, *plicate.*

HAB. Sandy sea coasts, frequent.

The somewhat acuminate leaves, acute, with the lamina on each side of the nerve hyaline at apex and forming a broad point similar to that of Rhacomitrium give this plant a very distinct appearance, and form a character which can hardly be considered unimportant ; the degree of acuteness however varies somewhat, the lower leaves, too, being sometimes quite broad and

obtuse at apex, and intermediate forms are also found ; the fruit, moreover, is in all respects that of *T. ruralis*, and on the whole it can hardly be conceded specific rank. It is usually a more robust plant, with longer leaves.

It is rarely found inland, but on some parts of our coast it is abundant, usually being embedded up to the apex in the sand ; in West Cornwall it is in places so abundant (while the typical form of *T. ruralis* is rare) that the late W. Curnow told me he had always taken the present plant for typical *T. ruralis*, and the roof-growing, obtuse-leaved plant for a variety. In this he followed Wilson, who in a supplementary page, intercalated in some copies of the Bry. Brit, corrected his description of *T. ruralis* Hedw. as follows : "Leaves more or less acute and tapering into the very rough hair-points. Abundant on sand-hills on the sea-coast, but not common in fruit."

The fruit is sometimes very scanty, but at others it fruits freely enough.

* **Tortula norvegica** Wahl. (*Barbula aciphylla* B. & S.) (Tab. XXVI. D.).

Very near to *T. ruralis*, but with the leaves *more acute*, the lower part of the stems usually reddish, the nerve excurrent in a *nearly smooth, reddish, shorter* hair-point.

Hab. On rocks, boulders, etc., in mountains. Very rare. Ben Heasgarnich and Ben Lawers, Perthshire. Fruit not found in Britain.

The alpine habitat, the more acute leaves, and the shorter, smoother, reddish hair-point make this plant at once distinct from the allied species. Forms occur, however, which connect it with *T. ruralis*, and it seems best to consider it a sub-species.

The name *norvegica* appears to have priority over *aciphylla*, and has been generally accepted.

20. Tortula princeps De Not. (*Barbula Muelleri* B. & S., Schp. Syn.) (Tab. XXVI. E.).

Tall, robust, resembling *T. ruralis*. Stems forked, with short nodose branches. Leaves *in interrupted rosulate tufts* along the stem and at the summit of the branches, *spreading, hardly if at all recurved*, large, broadly oblong-elliptic, obtuse, rounded, sometimes emarginate at apex ; margin revolute to or somewhat above the middle ; nerve stout, red, excurrent in a hyaline *slightly toothed* hair-point. Upper cells quite as large as in *T. ruralis*, *more pellucid* and less obscure, papillose, one row at margin often slightly distinct, compressed and transversely elliptical, rather more opaque. Capsule cylindric, slightly curved, long, dark brown. *Synoicous.*

Hab. Rocks and walls, rarely tree-trunks, usually in mountainous districts. Rare. Fr. spring.

This very handsome moss is readily distinguished from *T. ruralis* by the interrupted stems, and the leaves not recurved, with slender, faintly-toothed hair-points. The synoicous inflorescence is also an important character. Starved plants come near *T. intermedia*, but the large size of the cells, as well as

their greater distinctness, will at once distinguish them. The margins too, are more distinctly recurved. When growing in very dense tufts the interruption of the stems is less marked. The obtuse leaves and hyaline points will distinguish it from *T. norvegica*.

21. Tortula papillosa Wils. (*Barbula papillosa* C. M., Schp. Syn.) (Tab. XXVI. C.).

Short, rarely ½ inch high ; dark or olive green, in very small tufts or patches. Leaves spreading, when dry appressed to the stem and hardly twisted, *concave with the margins involute*, becoming still more so when dry, *broadly obovate-spathulate*, at apex rounded and obtuse or very shortly pointed ; nerve *thick*, spongy, *at back covered with very elevated papillae, gemmiparous above in front ;* excurrent in a mucro or longer cuspidate almost entire point ; cells at base rectangular, a few only hyaline ; above rounded, *larger than in the preceding plants of this section*, with rather thick walls, *pellucid*, smooth in front, at back sparsely and shortly or longly papillose. Capsule short, on a short seta, reddish brown.

HAB. Trunks of trees ; not uncommon. Sterile in Britain.

A quite distinct and easily known species, nearest to *T. laevipila*, but readily known by the gemmae and the concave leaves with involute margins, and very different areolation. The gemmae are oval or roundish articulate bodies, of a bright yellowish green very numerous on the younger leaves, but usually lost on the older ones.

The fruit has only been found in Australia.

Tribe 2. Trichostomeae.

Leaves usually lanceolate, tapering and acute, rarely oblong in outline ; upper areolation generally minute, rounded or angular, usually papillose and opaque ; basal from short and chlorophyllous to fairly lax and pellucid ; capsule cleistocarpous, gymnostomous, or with a peristome of 16 teeth entire or divided partially, or cleft to base into 32 filiform papillose segments, straight or twisted, on a very short basal membrane.

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41. BARBULA Hedw.

Slender, tufted plants, *usually with a dull, fuscous tinge*. Leaves small, *narrow, never wider above and usually gradually narrowed to a slender point ;* nerve mostly vanishing in apex, rarely distinctly excurrent ; basal cells small, rectangular, or similar to the upper, at apex usually very small, *often more or less*

incrassate. Capsule small, resembling that of the smaller forms of Tortula ; peristome from a *very short* membrane, teeth 16, straight, short and imperfect, or long and twisted, cleft or divided to base. Lid, calyptra, etc., as in Tortula.

A large genus, forming a fairly natural group, closely allied to the last, but with a habit and build distinct and easily recognised with a little practice. *B. unguiculata* and *B. convoluta* are the only British species the leaves of which, from their form, might give rise to a doubt as to their position.

B. Woodii Schp. from Killarney is, according to Braithwaite, only *Zygodon Mougeotii*.

DERIV.—Diminutive from Latin *barba*, a beard, alluding to the peristome.

1 { Nerve excurrent in a distinct mucro or cuspidate point ; (peristome long, twisted) 2
  { Nerve ending in or below apex 8

2 { Leaf-margin strongly revolute from base to apex..... 3
  { Margin plane or nearly so towards apex..... 5

3 { Stem tall, ls. widely cordate, nerve very stout..... *1*. cordata*
  { Stem short, ls. very small (about ½ line), narrower..... 4

4 { Leaves obtuse, mucronate..... *12. revoluta*
  { Leaves acute, cuspidate ..... *11. Hornschuchiana*

5 { Leaves tapering to acute points..... 6
  { Leaves more or less obtuse, mucronate or cuspidate..... 7

6 { Nerve shortly excurrent ; cells rounded..... *9. gracilis*
  { Nerve excurrent in a very long point ; cells more quadrate *10. icmadophila*

7 { Leaves under 1 line ; perichaetial ls. long, convolute..... *13. convoluta*
  { Leaves usually over 1 line ; perichaetial ls. not conspicuous *14. unguiculata*

8 { Leaves long, strongly sinuose at margin, toothed at apex..... *8. sinuosa*
  { Leaves not sinuose, entire (except sometimes *rubella*) 9

9 { Leaf margin nearly flat ; perichaetial ls. long, convolute... *13. convoluta*
  { Margin recurved ; perichaetial ls. not conspicuous..... 10

10 { Leaves short, often obtuse (peristome short)..... 11
   { Leaves tapering and acute, or long and sub-obtuse..... 12

11 { Ls. widely ovate-lanceolate ; nerve ending in the thick point ; green *1. lurida*
   { Ls. lanceolate, upper obtuse ; nerve ceasing below apex ; olive-brown *3. tophacea*

12 { Lower ls. red ; ls. often denticulate at apex ; paroicous or synoicous *2. rubella*
   { Lower ls. not red ; ls. entire ; dioicous..... 13

13 { Basal cells rectangular, more or less elongated, often thin walled..... 14
   { Cells almost uniform to base..... 18

14 { Leaf margin bi-stratose above..... 15
   { Margin not bi-stratose..... 16

15 { Apex sub-acute, channelled, often inflexed ; cells 6-7 μ *6*. Nicholsoni*
   { Apex narrowed to a linear, bluntish point ; cells 8-10 μ...*6. rigidula*

16 { Leaf-cells 9-10 μ ; plant glaucous..... *7*. glauca*
   { Cells 6-7 μ, plant not glaucous..... 17

17 { Ls. linear-lanceolate, long, spreading ; capsule cylindric.....*7. cylindrica*
Ls. lanceolate, short, straight, more acute ; capsule oblong.....*7*. vinealis*

18 { Ls. erecto-patent, some (at least) sub-obtuse ; robust ; peristome short *5. spadicea*
Ls. squarrose, more acute ; slender ; peristome long, twisted.....19

19 { Ls. trifarious, recurved, reddish, with short points.....*4*. recurvifolia*
Ls. less recurved, more tapering, lurid green.....*4. fallax*

1. Barbula lurida Lindb. (*Didymodon luridus* Hornsch.) (Tab. XXVI. F.).

Short, rarely more than ¾–inch in height ; in dense tufts, dull deep green, frequently tinged with brown, pale brown below ; stems rather slender, slightly branched. Leaves *erecto-patent, when dry erect, closely imbricated* (especially the upper ones), *hardly twisted ; concave, ovate-lanceolate, or deltoid-ovate*, quickly narrowed to a *wide, obtuse or slightly acute* point ; margin recurved below on one or both sides, slightly thickened above ; nerve rather wide at base (40–70 μ), but usually narrowing above, thick, vanishing just below the apex or reaching to the point ; cells small, *distinct*, hexagonal or rounded-quadrate, rather incrassate, *at the extreme base hardly altered*, a little larger and a few slightly elongated ; all smooth or faintly turgid and protuberant. Capsule on a purplish seta, oblong or shortly cylindric, lid conical-rostellate, often oblique ; peristome teeth not united at the base, short, slender, rather irregular, simple or cleft above, pale yellowish. Dioicous.

HAB. On rocks, most frequently calcareous, and stumps, not uncommon ; more commonly, but by no means always, near water. Fr. very rare, winter.

Although somewhat variable in habit and structure, this species may generally be known by its short, broad, concave, usually obtuse leaves, closely imbricated when dry ; *B. tophacea* differs in its narrower leaves and more elongated basal areolation ; *B. fallax* var. *brevifolia* very much resembles it, and when barren can sometimes hardly be distinguished except by its more straggling, laxer habit, somewhat softer leaves and distinctly narrower nerve. *B. lurida* is more rigid in its growth than most of the allied species. I have seen barren forms of *Ceratodon purpureus* which much resemble it, but under the microscope the resemblance would disappear.

The leaves vary much in form, in the degree of recurving of the margins, and in the width of their points ; one form has the margins widely recurved to the apex, which is very obtuse and rounded. Several continental species are very much like the present in the outline of their leaves, but differ in other points.

I have found *B. lurida* a frequent moss in the midland counties of England, but almost invariably sterile there.

* **Barbula cordata** Dixon (*Didymodon cordatus* Jur.) (Tab. XXVI. G.).

Resembling *B. lurida*, but *more robust*, taller, *more rigid*, dull green or usually brown. Leaves rigidly appressed when dry,

larger, *very widely cordate-triangular*, concave, margin *very strongly recurved on both sides to near apex ;* nerve *very stout*. 60–100 μ wide, often wider above than at base, *reaching to apex and nearly always excurrent in a short thick mucro*. Cells slightly less incrassate, at base *somewhat more rectangular and pellucid*. Bunches of *very numerous small purple-brown sub-spherical gemmae* frequently occur on the face of the nerve in the middle or lower part of the leaf. Fruit unknown.

Hab. Sunny banks, etc., very rare. Wall-top, Saunton, N. Devon, 1903 (*E. M. Holmes*).

This plant until recently was only known from Central Europe (Austria, Germany, and Switzerland). In 1902 it was gathered by Mr. W. E. Nicholson and myself in the Pyrenees, and Mr. Holmes detected it in the above locality in April, 1903. Our plant, though slightly less robust than the Pyrenean form, and with the leaves less widely cordate at base, has the nerve even more strongly developed and more distinctly excurrent. The large bunches of gemmae (resembling those of *B. rigidula*, but far more numerous and more conspicuous) are usually, if not constantly, present, and are a very obvious feature. The very wide cordate leaves with stout excurrent nerve and strongly recurved margins make the plant at once distinct from *B. lurida* under the microscope, although the habit alone is almost enough to determine it. It should be looked for on dry sunny banks in the south.

Dismier in *Rev. Bry.* 1921, p. 52, has given reasons for considering *B. cordata* more nearly allied to *B. rigidula* (of which he makes it a sub-species) than to *B. lurida*. There is certainly much to be said for this view, but the question does not appear to me to be certainly decided, and for the present I retain it under *B. lurida*.

2. Barbula rubella Lindb., Musc. Scand. p. 22 (1879). (*Bryum rubellum* Hoffm. ; *Didymodon rubellus* B. & S., Schp. Syn ; *Mollia laxula* Stirt. in Ann. Scot. Nat. Hist. ix, 175) (Tab. XXVI. H.).

Taller, 1–2 inches high, in large soft patches, bright or deep green above, *below bright rusty red ;* stems slender, branched. Leaves *spreading and recurved* from a more erect whitish base, *when dry flexuose and slightly curled*, the uppermost larger, long, *narrowly linear-lanceolate*, with a short acute point ; margin widely recurved to near apex, *faintly and irregularly denticulate at point ;* nerve vanishing in the apex or excurrent in a minute apiculus ; cells *quadrate, obscure*, papillose, *at base narrowly elongate-rectangular*, pellucid. Perichaetial bracts long, sheathing ; seta, long, red ; capsule erect, cylindrical, pale brownish green, reddish brown when old ; annulus distinct, fragile ; *lid rostellate, usually very short, oblique ;* peristome teeth united at base in a very short membrane, 16, short, pale red, linear, with a median line but rarely divided, nodose at the articulations. *Paroicous or synoicous.*

Var. β. *dentata* Schp. Plant taller, leaves longer, margin recurved only to about the middle, *strongly dentate at apex.*

Var. *γ. ruberrima* Berg. (*B. ferruginascens* Stirt. in Ann. Scot. Nat. Hist. ix, 176). Plants taller, with *very slender branches*, all red or only the tips yellowish ; leaves *all very short*, appressed and slightly twisted when dry, *from a widely ovate base shortly acuminate to a stout acute point*, mostly formed by the nerve, *entire ;* lower cells smaller and shorter.

HAB. Rocks, stony places, walls, etc., most abundant in mountainous regions ; very common. The var. *β* on mountain rocks, not common ; the var. *γ* in similar situations, principally near streams and waterfalls, rare. Fr. autumn.

The specific name is very appropriate, the bright, brick red colour of the lower leaves being almost invariably present and very characteristic ; indeed, it may nearly always be relied upon to distinguish the species from allied plants. The var. *dentata* is considered by some authors a distinct species, and Limpricht describes it as *Didym. alpigenus* (Vent.), characterising it especially, in addition to the toothed leaves less recurved at margin, by the cells of the lid being arranged in oblique rows, twisting to the right, not straight as in *B. rubella ;* he also describes the lid as short (only ½ length of capsule). Among the numerous British specimens in my herbarium with distinctly toothed leaves and less recurved margins, however, none have the oblique rows of cells in the lid, which moreover is extremely variable in length, being at times very short, at others much longer than in typical *B. rubella*. Whatever the value of *B. alpigena* therefore, it can scarcely be correct to unite it with Schimper's variety, nor can we claim it as British. The antheridia in this variety are rare, and are often quite absent on fertile plants ; I have, however, found them occasionally mixed with the archegonia ; and as, even when they are absent from the lower bracts, numerous paraphyses are constantly found, the suppression of the antheridia is clearly due rather to simple abortion than to any actual difference in the character of the inflorescence. The var. *ruberrima* is even more distinct in habit. I am inclined to attribute to it a higher rank than that of a variety. It is extremely constant in its characters ; it has never, so far as I am aware, been found in fruit, while *B. rubella* is scarcely to be found without ; and I have scarcely ever seen a plant that could be said to form an intermediate link with the type. It is very much like *Didymodon rufus* Lorentz, but that has larger, wider leaves, with smaller basal cells and narrower nerve. Two slightly different forms occur, one having the basal cells all wide and short (about 3 × 1), the other having the juxta-costal cells at base longer (4 or 5 × 1).

A further character has quite recently been pointed out to me by Herr Loeske. Red multicellular gemmae, subglobose or sausage-shaped, occur on the radicles with which the older parts of the stem are clothed ; similar to those that occur on Leptobryum, etc. I have found them present on all the specimens I have examined of the var. *ruberrima* but have not detected them on the type. Moenkemeyer has recently described a species, *Barbula botelligera*, (from the small, sausage-shaped gemmae) from central Europe, which has the same gemmae, and is closely allied to our variety. It shows, however, some slight vegetative differences, and its identity with our plant is not fully established. I incline however to think that in all probability our variety will ultimately have to be united with *B. botelligera* as a distinct species, or as a sub-species of *B. rubella*.

3. Barbula tophacea Mitt. (*Trichostomum tophaceum* Brid., Schp. Syn. ; *B. brevifolia* Lindb. Braithw. Br. M. Fl.) (Tab. XXVI. I.).

In dense irregular tufts, *olive green or brown above, below* frequently much encrusted with hard calcareous matter and

whitish; very variable in height, usually about 1 inch high, frequently more. Leaves spreading, the uppermost rather the longest, when dry incurved and slightly twisted, *oblong-lanceolate or lingulate, broad at apex and obtuse or very shortly pointed*, carinate; margin revolute, *entire;* nerve strong, *vanishing below the apex;* cells at apex *irregularly elliptic*, the marginal smaller, crenulate-papillose, below sub-quadrate, at base shortly rectangular; *all thick-walled, pellucid, and very distinct*, the upper slightly papillose. Seta rather stout, dark red; capsule *elliptic or broadly oblong, rather wide-mouthed when dry and empty*, dark brown; lid oblique, longly rostellate, annulus almost obsolete, persistent; peristome teeth *short, erect*, from a very short basal membrane, divided almost to the base, the branches filiform, unequal, sometimes partly united, reddish. Dioicous.

Hab. Wet calcareous walls and springs; common. Fr. winter.

Easily known by its colour, the obtuse, lingulate leaves with comparatively short nerve, and the very distinct, rounded upper cells, and when in fruit by the dark, rather wide-mouthed capsule and short slender peristome. It is most variable in the size of all its parts, and in the form of its leaves, and numerous varieties have been described, none of which, however, seem marked by any important characters; such are the var. *brevifolia* Wils. (excl. syn.), with broader, shorter, more acute leaves; var. *acutifolia* Schp. with longer, narrower, acuminate, acute leaves, spreading and recurved. Sometimes it is tall and robust (*forma luxurians* Braithw.), at others it is so minute as to resemble almost exactly a species of Pottia such as *P. lanceolata*, or it may be even still more dwarf. The leaves when moist have a pellucid appearance quite different from those of most species of the genus.

4. Barbula fallax Hedw. (Tab. XXVI. J.).

In wide loose tufts or patches, of a *dull brownish green, frequently with a reddish tinge*, ½–2 inches high; stems slender, with fastigiate branches. Leaves rather distant, *spreading, recurved or variously arcuate*, when dry appressed, closely imbricated, slightly twisted, often giving the stems, in the slender forms especially, a catenulate appearance; the uppermost, longer leaves more distinctly twisted; *from a wide base gradually narrowed to a lanceolate tapering point*, which is either wide or more frequently rather narrow and sub-acute; carinate, faintly plicate at base on each side of the nerve; margin revolute to beyond the middle; nerve strong, reddish, reaching to apex, rarely very slightly excurrent; in section very prominent at back, on upper surface *plane or concave*, the anterior row of cells *small;* upper cells roundish or hexagonal, irregular, or more often regular in shape and arrangement, small, incrassate, papillose, at base *slightly elongate, but not much altered*, a few (rarely more) sub-rectangular and pellucid. Seta red, capsule oblong or cylindric, erect or nearly so; lid long, *acutely subulate-rostrate;* peristome deep red, *long, delicate, much twisted*, with a very narrow basal membrane. Dioicous.

Var. β. *brevifolia* Schultz (*Tortula brevifolia* Sm.). *Slender*, often decumbent; leaves *more distant, short, ovate-lanceolate, broad at point, hardly twisted when dry*; capsule *small*, peristome shorter.

HAB. Clay banks, waste places, walls, etc.; common. The var. β, fallow fields and bare ground. Fr. winter.

A variable plant; in the typical, robust form generally known by its colour, spreading and even recurved leaves, and very acute lid, but liable in some states to be confused with *B. rigidula*, *B. spadicea*, and other species. The areolation, almost uniform to the base, will easily distinguish it from *B. cylindrica*, *B. vinealis*, and *B. rigidula*; the narrower nerve and somewhat less distinct areolation will separate short-leaved forms from *B. lurida*; for the differences between it and *B. spadicea* and *B. gracilis* see under those species. Occasionally forms are found very near *B. recurvifolia*, which is hardly separable except by a *tout ensemble* of characters; the short, much recurved, highly papillose leaves, with the reddish hue, scarcely being found simultaneously on any form of the present plant.

The leaves of *B. fallax* vary much in the degree of tapering of their points, in the relative papillosity, and in the areolation; the latter is usually distinct and rounded in the upper part, often arranged in regular series, but it is frequently found small, irregular and more opaque, as in *B. spadicea*. In the perichaetial bracts in this and allied species the basal cells are more lax and rectangular than in the leaves.

The variety *brevifolia* is a marked one (though intermediate forms may be found), often of an olive brown or purplish colour, very slender, and with the fruit usually sparingly produced; and very distinct in appearance owing to the small, short leaves. It has some resemblance to *B. lurida*; but the nerve is narrower, the leaves less concave and usually more acute.

* **Barbula recurvifolia** Schp. (*Tortula fallax* var. *recurvifolia* Wils.; *Barbula reflexa* Brid., Braithw. Br. M. Fl.) (Tab. XXVII. A.).

Differs from *B. fallax* in the stems *deep reddish brown* with paler, yellowish tips, the leaves *strongly squarrose-recurved*, somewhat trifarious in their arrangement, broad and *short, shortly and abruptly pointed*, hardly tapering, the margins less strongly recurved, the cells and back of nerve more highly papillose, the nerve not excurrent. Nerve in section showing *almost homogeneous* cells, the guide-cells (2) little larger than the rest. Fruit as in *B. fallax*, but rare.

Var. β. *robusta* Braithw. *Tall*, 3-5 inches high, in loose tufts; leaves closer, *broader and thicker*.

HAB. Sand and earth, usually on limestone soil; not common. The var. β, Sligo (*Moore*).

While fully agreeing with those writers (Boulay, Husnot, etc.) who unite this with *B. fallax*, I am inclined to think it must stand higher than a variety, as the characters, though all vegetative, are not unimportant, and are fairly constant. Forms of *B. fallax*, indeed, have the same short, broadly pointed

leaves, others have them strongly recurved, and so on : but in *B. recurvifolia* the characters above described give a general appearance rarely to be found in any form of true *B. fallax*. The rusty red colour, slender stems, and short recurved leaves will render this plant easily recognised, but it should always be verified with the microscope.

The fruit is extremely rare, and has, perhaps, not been found in Britain.

5. Barbula spadicea Mitt. (*Trichostomum rigidulum* Sm. pro parte *Limneria viridula* Stirt. in Trans. & Proc. Bot. Soc. Edin. xxvi, 428) (Tab. XXVII. B.).

Resembling *B. fallax*, but *more robust*. Leaves larger, *erecto-patent, straight, rarely spreading or recurved*, from a broad base gradually narrowed to a *broad, usually hardly acute point ;* nerve *strong*, wide at base ; cells *small, angular, usually irregular*, sub-hexagonal, rather obscure ; *hardly altered at base* except a very few of the lowest. Nerve in section showing a median row of about 6 *well marked, larger* guide-cells. Seta and capsule as in *B. fallax ; peristome much shorter, the teeth hardly twisted*, filiform, from a narrow basal membrane.

The lid is sometimes very long, and is especially so in the plant named *Limneria viridula* by Stirton ; but it is not a constant character, nor is it correlated with any other characters.

Hab. Wet rocks and sandy shores of mountain streams ; not common. Fr. late autumn.

Although in its peristome resembling *B. tophacea* or *B. rigidula*, and on that account long united with the latter, the affinity of this species is closest with *B. fallax*, from which it is very difficult at times to separate barren plants. It has been suggested that the cells in the present plant, irregularly angular, afford a distinguishing character, those of *B. fallax* being more distinct, rounder, and more regularly seriate, but although this frequently holds good, I have examined specimens of undoubted *B. fallax* with precisely the areolation typical of the present species. The leaves in *B. spadicea*, again, are sometimes said to be straight and appressed when dry, not twisted as in *B. fallax*, but this is undoubtedly an error. According to my own observation the most useful character is the direction of the leaves when moist, straight and erecto-patent in *B. spadicea*, very rarely flexuose or recurved as is frequently the case in *B. fallax*. They are, too, always broad at the points, but the same may be observed, frequently though not usually, in the latter species. In most cases however, the present species is a much more robust plant with larger leaves. The stout nerve is also a useful character.

B. rigidula differs in the smaller, narrower-pointed leaves, with more elongated basal areolation.

6. Barbula rigidula Mitt. (*Didymodon rigidulus* Hedw.; *Trichostomum rigidulum* var. *densum* B. & S., plur. auct.) (Tab. XXVII. C.).

Growing in *small dense tufts or cushions*, rarely 1 inch high, dull or yellowish green above, reddish brown below. Leaves rather crowded, resembling those of *B. fallax* but rather *shorter*,

more narrowly acuminate to a straight almost linear point; straighter and less recurved, more concave, *hardly papillose*. Margin recurved below, *slightly thickened above;* nerve brown, lost in the rather opaque point. Areolation small, 8–10 μ, dense, rounded-hexagonal, rather obscure in the point, more distinct below, faintly papillose, towards base becoming quadrate or elongated, *the lowest cells all shortly rectangular and pellucid*. Groups of small, sub-spherical stalked *gemmae* occur, usually in some abundance, in the axils of the leaves, especially the upper ones. Capsule oval-oblong, smooth and shining; lid rather short, less acute than in *B. fallax;* peristome teeth from a short basal membrane, *short*, free or united, oblique or slightly twisted. Dioicous.

HAB. Walls and rocks, frequent. Fr. late summer and autumn.

When the fruit is present and in good condition, the short, hardly twisted peristome, taken in conjunction with the rectangular basal cells, easily distinguishes *B. rigidula* from its allies; but without fruit it is difficult to separate from *B. vinealis*. That species is usually of a more decided green tint, the leaves more acute in the acumen, with more strongly papillose areolation, obscure with chlorophyll above; stunted specimens however may prove difficult to determine. It is probable however, that the presence of the gemmae, which was first pointed out to me by Mr. W. E. Nicholson, affords a safe and constant test of *B. rigidula*. I have examined all the gatherings I possess, and have invariably found them present, though in a few cases they require a good deal of looking for. This character will also distinguish it from *B. fallax* and the other allied species, except perhaps *B. gracilis*, in doubtful cases. The sub-linear, opaque, not very acute subula, is usually a well marked and distinctive feature. *B. cylindrica* is known by its longer, larger, curved and flaccid leaves, *B. fallax* and *B. spadicea* by the short, hardly altered basal areolation, and the larger, more broadly pointed leaves; *B. gracilis* and *B. icmadophila* by the well defined cells and smooth excurrent nerve. The time of fruiting in these closely allied plants should be noted; in *B. fallax* the capsules are ripened almost in mid-winter: in *B. rigidula*, usually at least, in late summer and autumn; in *B. vinealis* in spring. *B. rigidula* grows in small tufts, almost invariably on rocks or walls, while *B. fallax* is frequently, indeed usually, terrestrial, and forms laxer, irregular patches.

* **Barbula Nicholsoni** Culmann (Tab. XXVII. E.).

Differs from *B. rigidula* in the *more robust habit, broader* leaves with *broader often obtuse or sub-obtuse, sometimes sub-cucullate points*, the nerve *stout*, percurrent, and forming at apex with the thickened margins an incrassate point. Leaves when moist often more erect. Cells rather smaller, 6–7 μ.

HAB. Moist stones near water; very rare. Sussex; Devon; Gloucestershire; Middlesex; Yorkshire. Fruit unknown.

Forms somewhat connecting this with *B. rigidula* indicate, I think, that it should be considered a sub-species of that plant. Axillary gemmae occur, but apparently not so constantly as in *B. rigidula*. The upper part of the leaf is less narrowed, and the borders somewhat incurved so that the apex

is channelled, and sometimes the point is inflexed. Without being a very marked plant the above characters will make it easily recognisable, even in the field. The thickened leaf-borders will distinguish it from *B. spadicea*

It has not been found outside Britain.

7. Barbula cylindrica Schp. (*Zygotrichia cylindrica* Tayl.) (Tab. XXVII. F.).

Plants rather soft, *in loose tufts or patches*, olive green above, reddish brown below; stems flexuose, slender, 1–2 inches high. Lower leaves rather short and distant, the upper crowded and longer, *flexuose-curved, longly linear-lanceolate from a rather long ovate erect base, widely spreading, much twisted and curled when dry*, very rarely faintly denticulate at apex; margin narrowly recurved, usually plane above the middle; nerve vanishing in the rather wide point; areolation small, irregularly subquadrate, *very obscure, papillose*, more regularly quadrate below, *all the lowest shortly rectangular*, small. Seta long, flexuose; capsule *oblong-cylindric*, dark chestnut brown, smooth, shining; lid acutely rostrate; peristome spirally twisted, short, not forming a complete turn, red, turning pale when old. Dioicous.

Hab. Walls, banks of streams, etc., principally in calcareous districts; frequent. Fr. rare, spring and summer.

Resembling *B. fallax* much in appearance, this species may generally be distinguished by its greener tufts and softer texture, the leaves also are longer and narrower in the limb, frequently horizontally flexuose in their direction. Under the microscope the obscure, much smaller and usually more angular upper cells, and the basal cells, all more or less quadrate or rectangular, easily distinguish it. The leaves too are less recurved, and the margin less strongly revolute. The basal cells are sometimes considerably elongated, and pellucid.

*** Barbula vinealis** Brid. (*B. cylindrica* var. *vinealis* Braithw., Br. M. Fl; *B. viridescens* Stirt. in Ann. Scot. Nat. Hist. xv, 110) (Tab. XXVII. G.).

Closely allied to the above, but smaller, shorter, *in denser tufts*. Leaves *shorter, straighter, narrower in the point*, margin recurved to above the middle. Capsule *shorter*, with a usually rather shorter lid.

Hab. Walls and rocks; often on sandstone, roots of trees, etc. Frequent. Fr. rare, spring.

Usually known from *B. cylindrica* without much difficulty by its straighter, shorter, more acute leaves, which are more closely appressed to the stem when dry, and, the upper ones especially, somewhat spirally twisted; indeed, the closely twisted, somewhat rigid and bristly points of the comal leaves give a very characteristic look to the plant under the lens when dry. Intermediate forms, however, may sometimes be found, and it is not without hesitation that I have allowed the present plant to rank as a sub-species rather than as a

simple variety of that species. In some respects it more closely resembles *B. rigidula;* but the leaves in that are usually rather wider, with the upper cells less obscure and almost smooth, and with a distinct, opaque, sub-linear point. The anterior cells of the nerve are similar to those of *B. gracilis* (see note on that species), and this will separate the present species from *B. fallax* var. *brevifolia*, which it often resembles.

The apical cell of the leaf in *B. vinealis* is often acute, smooth and pellucid.

* **Barbula glauca** Dixon (*Didymodon glaucus* Ryan in Rev Bry. 1901, p. 39) (Tab. XXVII. D.).

In small, *dense*, *glaucous* tufts, resembling very small forms of *Weisia verticillata*, but with the leaves crisped when dry; whitish below; delicate in texture. Stems about ½ inch high, innovating above. Leaves interruptedly tufted, patent, very narrow, not greatly widened at base, linear-lanceolate, rather abruptly narrowed at tip, as in *B. rigidula*, but more acute. Margin *very narrowly* recurved to near apex. Nerve stout. Cells pellucid, papillose, the basal hyaline, larger, sub-quadrate, very little elongated. Fruit unknown.

HAB. Hollow in a chalk bank, Shoreham, Sussex (*Nicholson*). Richmond, Yorkshire (*Barnes*). Fruit unknown.

To my mind a very difficult, not to say unsatisfactory plant, possibly a calciphilous form of some one or other of our well known species, but differing slightly from all in one way or another. I have placed it under *B. vinealis* provisionally; it seems near to *B. rigidula* in the leaf form and apex, but it lacks the thickened border, and may be nearer *B. vinealis*, of which the continental plant at least has the rather distinctive hyaline apical cells.

It has been found on the continent in Norway and Styria.

8. **Barbula sinuosa** Braithw. (*Dicranella sinuosa* Wils. MS.; *Didymodon sinuosus* Schp., Syn.) (Tab. XXVII. H.).

Deep or yellowish green, in low flat patches or small tufts *rarely an inch high, usually much shorter*, but often more robust than *B. cylindrica*. Leaves *larger, longer, linear-lanceolate* or *widely linear from a narrow-oblong base*, much curled when dry, with the margin *plane or very slightly recurved below*, in the upper half *very sinuose, notched, irregular and fragile, at apex often coarsely and irregularly denticulate;* cells resembling those of *B. cylindrica*, but *more distinct*, pellucid, and regular, and very slightly larger, at base rectangular, usually lax, hyaline and thin-walled.

HAB. Walls and stones chiefly in calcareous districts. Not common. Fruit unknown.

In the absence of fruit the position of this curious moss must remain uncertain, but I am unable to attribute to it a very close affinity with *B.*

cylindrica. I have gathered it in many localities, principally in the Midlands, and have always found it remarkably constant, and never showing the slightest tendency to approach that species or *B. vinealis*, with both of which I have found it growing, and, indeed, intermixed, always retaining its peculiar characteristics. The form of the leaves, often almost linear, not very much wider at the base than in the middle, their more succulent, fragile texture, yellowish colour, and more distinct areolation, frequently very thin, lax and hyaline at the base, are points which, considering their constancy, have considerable value as specific characters, quite apart from the peculiar configuration of the upper part of the leaf. In this latter respect it bears a certain resemblance to *Trichostomum tenuirostre*, but that has narrower more acute leaf-points, the margins quite plane, the basal areolation still more lax and hyaline, and the upper cells more obscure.

9. Barbula gracilis Schwaeg. (*B. acuta* Brid., Braithw. Br. M. Fl.) (Tab. XXVII. I.).

Short, ½–1 inch high, *in dense tufts*, olive green, frequently becoming brown. Stems straight, rather rigid; leaves *small, straight, erecto-patent*, appressed when dry and very slightly twisted, from an ovate base gradually but quickly *tapering to an acute point*, concave; margin widely reflexed below, plane above, nerve strong, reddish, *forming the greater part of the leaf point, and in the upper leaves at least excurrent in a short red acute mucro*, in section *convex* on the upper surface, not prominent at back, the anterior row of cells large; cells small, 9–10 μ, *rounded, distinct*, incrassate, *smooth*, at base small, *shortly rectangular*. Small and inconspicuous gemmae occasionally occur in the axils of the upper leaves. Perichaetial bracts wide, sub-sheathing, *the nerve more longly excurrent in a somewhat flexuose point*. Capsule oval-oblong, *small*, short; lid long, slender; peristome short, slightly twisted. Dioicous.

Var. β. *viridis* B. & S. *Bright green*. Leaves softer, more twisted when dry; cells *larger*, 10–15 μ, more angular, rectangular-rounded, or sub-quadrate. Gemmae more constantly present.

Hab. Walls and bare ground, principally in calcareous districts. Rare, but probably overlooked. The var. β rare. Sterile in Britain.

Somewhat resembling small forms of *B. fallax*. The leaves, however, are more acute, shorter, straighter, and more erect, and the areolation smooth and pellucid. The nerve section will distinguish the two in doubtful cases, and, indeed, the difference in its structure can be observed without cutting a section. If the leaf be laid flat and the upper surface viewed with a moderately high power it will be seen that in *B. gracilis* the *short, rectangular-rounded* cells of the lamina are continued across the nerve, while in *B. fallax* this is not the case (except in the acumen), but the surface of the nerve is formed of *elongated*, narrow-linear cells. (The nerve should be examined at some little distance above the base). It is still more like *B. rigidula*, and there is little in the barren state to distinguish them, but the more distinct rounded cells in the present plant with the nerve usually distinctly excurrent in some of the leaves, and the perichaetial bracts especially long-cuspidate and flexuose.

B. Hornschuchiana has the leaves less narrowly tapering, the margin much more widely revolute, and the nerve stouter and more clearly excurrent. The next species is the most closely allied, but differs in the more suddenly narrowed leaves with longer, finer acumen and more excurrent nerve. The margin in both species is rather widely but not strongly reflexed, like the side of a dish, the extreme edge being in addition irregularly and more narrowly revolute.

10. Barbula icmadophila Schp. (Braithw. Br. M. Fl., Vol. II., Suppl.) (Tab. XXVII. J.).

Taller and more slender, 1–2½ inches high. Leaves *more suddenly contracted to a narrow, almost subulate acumen, the greater part formed by the longly excurrent nerve ;* cells a little larger, *very distinct, more quadrate or angular.* Capsule *narrowly elliptical.*

HAB. Wet rocks, chiefly on mountains. Very rare ; Skye ; Ben Lawers. Sterile. Fr. late summer.

Very near the last species, but quite distinct in the longly excurrent nerve, the more angular areolation, and the longer narrower capsule. Our plant is a very short, small form. The fruit has been found in Tirol, and I have gathered it fruiting freely in Norway.

11. Barbula Hornschuchiana Schultz (Tab. XXVII. K.).

In low bright green tufts or patches, about ½-inch high. Stems slender ; leaves spreading, when dry *rigidly arcuate-incurved and spirally twisted ; very small,* rather larger at the top of the stem, *ovate-lanceolate or narrowly triangular, gradually acuminate from the base or just above to an acute point, sharply mucronate or cuspidate with the stout, yellowish, excurrent nerve ;* margin *very widely and strongly revolute in its whole length,* reaching to or almost to the nerve in the upper half of the leaf ; upper cells rounded-quadrate, *distinct,* incrassate, obtusely papillose, at base very shortly rectangular, rounded at angles, rather incrassate. Perichaetial bracts larger, longer, sheathing, with plane margins, longly acuminate, with narrower nerve. Seta orange red below, pale above ; capsule small, narrowly elliptic or sub-cylindric ; lid long-beaked, peristome teeth from a very narrow membrane, rather long, purple, much twisted. Dioicous.

HAB. On the ground in fields, old quarries, and on walls ; not common Fr. spring.

This and the two following species have a certain affinity and are distinguished by their small size, much smaller leaves, paler seta and more highly differentiated perichaetial bracts from the other species of the genus. The present plant may easily be overlooked as a small state of *B. fallax* or some other moss, but it is recognised almost at a glance by the stellately-spreading, small, tapering, acutely pointed leaves with strongly revolute margins ; *B. revoluta* has the leaves much less tapering, more linear and obtuse at the point.

12. Barbula revoluta Brid. (*Tortula revoluta* Schrad.) (Tab. XXVII. L.).

In very dense, low, smooth tufts or cushions, bright or dull green, ¼–½ inch high, rarely taller, Leaves crowded, erecto-patent or spreading, slightly recurved, *closely and very neatly curled when dry, very small, ligulate-oblong from a rather broader base, scarcely tapering above,* at apex *rather obtuse* and apiculate; margin *very widely and strongly revolute from just above base to apex,* reaching almost to the nerve in the whole of the upper part; nerve *very thick, and wider* above than in the lower half, *usually excurrent in a small mucro or apiculus;* cells rounded-quadrate, *obscure,* papillose, at base rectangular, pellucid; all rather incrassate, rounded at the angles. Perichaetial bracts much longer than the leaves, sheathing. Seta orange, paler above, slender, *twisted to the right when dry;* capsule elliptical; lid rather short; peristome much twisted. Dioicous.

Hab. Limestone walls and mortar; frequent. Fr. spring and summer.

As pointed out above, this species is at once recognised by its much less tapering, less acute leaves, from *B. Hornschuchiana,* and is indeed a plant in no way likely to be confused with any other; the thick nerve and revolute margin give a solid, opaque appearance to the leaves quite different from that of *B. convoluta;* and the colour is usually a deeper green, less yellow than in that species.

13. Barbula convoluta Hedw. (Tab. XXVIII. A.).

Rather taller, ½–1 inch high, in more swollen cushions, *bright yellowish green.* Leaves erecto-patent, *recurved,* crowded, strongly curled when dry; small, *oblong-lanceolate or ligulate,* slightly narrowed but not tapering at apex, somewhat acute, or rather obtuse and apiculate; *margin slightly recurved at base on one* or both sides, elsewhere plane, crenulate with bifid papillae; nerve yellowish, pellucid, papillose at back, *vanishing in or below apex or very shortly excurrent in a minute apiculus;* areolation sub-quadrate, *obscure,* small; at the base pellucid or hyaline, elongate-rectangular. Perichaetial bracts *long, convolute, sheathing,* apiculate, inner nerveless; seta long, slender, *straw-coloured, twisting to the left when dry;* capsule small, oblong, reddish brown; annulus distinct; peristome much twisted. Dioicous.

Var. *β. sardoa* B. & S. (*Trichostomum undatum* Schp., Syn.; *Barb. commutata* Jur., nonn. auct.). *Taller,* in dense tufts; leaves, especially the comal, *longer, less recurved, undulate at margins;* capsule *longer.*

Hab. On the ground and on wall-tops; frequent. The var. *β* rare. Fr. spring.

Readily known by its pale yellow slender seta, and the long sheathing perichaetial bracts. Otherwise, it much resembles small states of *B. unguiculata*, but the margin is only very slightly recurved, the nerve usually vanishing and never so stoutly and distinctly excurrent as in that species. The leaves are much more translucent than in the two previous species, and less neatly and regularly curled when dry than in *B. revoluta*.

14. Barbula unguiculata Hedw. (*Bryum unguiculatum* Huds.) (Tab. XXVIII. B.).

A very variable plant, usually growing in small dense tufts, or larger patches; dull or yellowish green, ¼–1 inch high. Leaves erecto-patent and recurved, or sometimes spreading and slightly squarrose, *closely imbricated and spirally twisted when dry*, with the nerve at back pale and glossy; *lingulate or oblong-lanceolate*, slightly narrowed towards apex, but never acuminate, obtuse, *mucronate* with the stout yellowish excurrent nerve, which is papillose at back; margin *recurved, plane towards apex;* basal cells rather small, narrow, pellucid, yellowish, the upper small, sub-quadrate, obscure, thin-walled or incrassate, papillose. Perichaetial bracts longer, sometimes much elongated, narrower, sub-sheathing, but not convolute. Seta variable in length, *brownish red or purple*, paler above; capsule cylindric or narrowly oblong, lid rostellate or rostrate, slightly curved, variable in length. Annulus none. Peristome teeth *long, very slender, forming two complete turns of a spiral*, narrowly twisted at base, more loosely at apex, from a very short basal membrane. Dioicous.

Var. β. *cuspidata* B. & S. (*Barbula cuspidata* Schultz). *More slender;* leaves and perichaetial bracts narrower, *with longer cuspidate points*, straighter; seta *slender*, often flexuose.

HAB. Banks, walls, and bare ground; very common. The var. β frequent. Fr. winter or spring, but variable.

One of the commonest species of the genus, and extremely variable. Many varieties have been described, but the characters on which they are founded are very slight and unimportant. Almost every variety of leaf form and direction may be found from shortly and broadly oblong and very obtuse to narrowly linear or elongate-lanceolate, and from straight and erecto-patent to squarrose-recurved. The apex is sometimes, but rarely, narrowed so as to appear at first sight acute, especially when folded laterally, but when flattened out it will be found to be invariably more or less obtuse, the lamina often reaching slightly higher on one side of the nerve than the other. The spirally twisted leaves with pale shining nerve in the dry state are very characteristic, and the obtuse mucronate apex gives the leaf a distinct appearance by which the plant is easily known in the field; it is a taller plant of firmer texture than any of the three preceding species, and could hardly, except in very short and delicate forms, be mistaken for any of them; and the margin regularly recurved, and nerve excurrent in a distinct mucro, are sufficient points of difference in doubtful cases. Young or starved forms may be confused with *B. convoluta*, but the margin in that plant is only slightly recurved, and the nerve rarely excurrent, the perichaetial bracts and seta quite different.

Mr. E. F. Shepherd sent a curious form from Staines with aggregate setae, and the old setae persistent, which occurred in several stations, and retained its characters for at least some years.

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42. **LEPTODONTIUM** Hampe.

Leaves *spreading or squarrose-recurved*, rather wide, mostly flexuose, *with serrulate or notched margins*. Capsule narrow, cylindrical; peristome of 32 filiform *smooth* teeth, *straight, erect*, more or less unequal and here and there united in pairs. Dioicous.

The three British species of this small genus are readily known by the peculiar habit, the form and structure of the leaves, and a certain succulent texture, and with the few exotic and continental species appear to form a well-defined group, hardly approached by any of the other British species of the Order except *Pleurochaete squarrosa*.

It is curious that all three species seem to have their head-quarters in Britain, and two of them have not found been elsewhere.

DERIV.—λεπτο-(lepto) slender, and ὀδοντ-(odont) tooth.

1 { Leaves tipped with clusters of gemmae.....*1. gemmascens*
  { Leaves not tipped with gemmae.....2

2 { Leaves not bordered, nerve vanishing.....*2. flexifolium*
  { Leaves with pale border, nerve excurrent.....*3. recurvifolium*

1. **Leptodontium gemmascens** Braithw. (*Didymodon gemmascens* Mitt.; *Did. flexifolius* var. *gemmiferus* Schp., Syn.) (Tab. XXVIII. C.).

Loosely tufted; 1–1½ inches high, bright green; stems green, fragile, scarcely branched. Leaves *oblong-lanceolate or lanceolate-acuminate, tapering, erecto-patent or spreading*, not recurved, rather crisped when dry, *margin plane or erect*, slightly sinuose or undulated, finely spinulose-dentate at apex; *nerve reaching apex, in the upper leaves excurrent and tipped with a bunch of green, obovate gemmae;* basal cells rectangular, the upper irregularly hexagonal, obscure and opaque; a single marginal row somewhat more pellucid.

HAB. Old thatched roofs, very rarely on trees; Southern counties of England; Yorkshire; near Dundee. Fruit unknown.

Originally considered a variety of the next species, but quite distinct in the form and direction of the leaves. The gemmae are by no means confined

to the tip of the leaf, but may be found, often abundantly, in the axils of the upper leaves. Mr. Mitten says that it is usually found on thatch that is just beginning to go, not on very old and decayed thatch.

It has been suggested that the differences between this plant and the next may be simply the results of the peculiar habitat. This is, however, disproved by the fact that *L. flexifolium* is also found on thatch. Mr. G. B. Savery finds both species growing mixed together on thatched roofs in Devonshire, *L. flexifolium* tending to exterminate the present species as the thatch decays. In Sussex, where both grow on roofs, Mr. Nicholson finds the present plant confined to straw thatch while *L. flexifolium* grows on thatch made from heather.

2. Leptodontium flexifolium Hampe (*Bryum flexifolium* Dicks.; *Didymodon flexifolius* Hook. and Tayl., Schp. Syn.) (Tab. XXVIII. D.).

In wide patches, 1–2 inches high, bright or yellowish green; stems usually at least *reddish*, slender, rather flexuose, fragile. Leaves distant, the comal larger, *erecto-patent or spreading and squarrose-recurved*, small ($\frac{1}{2}$–$\frac{3}{4}$ *line in length*), concave-carinate, rounded and flexuose; when dry *erect and crisped; shortly oblong-lingulate*, apiculate at apex or shortly pointed; *margin recurved at base;* in upper third strongly, irregularly spinulose-denticulate; nerve narrow, yellowish, *vanishing below the apex;* cells at base shortly rectangular, above rounded-hexagonal, chlorophyllose, incrassate, papillose on both sides; *a single row at margin pellucid*, crested with distinct single papillae on the edge. Perichaetial bracts sheathing. Seta slender, yellowish; capsule narrowly elliptic or cylindric, yellowish brown with a red mouth; lid shortly rostellate; peristome teeth slender, fragile, yellowish, smooth. Male plant more slender, inflorescence terminal.

HAB. Peaty and gravelly soil, rarely on thatch, not common. Fr. early spring, rarely autumn.

Known at once by the flexuose, recurved, distant leaves, sharply toothed at apex, shortly and widely lingulate, rather acute, but not tapering at the points. The whole plant has a succulent, fragile texture. Axillary and terminal buds, or gemmiform bodies are often formed, which are readily detached and serve to propagate the plant. It is most frequently found in the barren state. I have gathered a curious form on Ben Douran, Argyllshire, reddish, with the leaves sometimes but not always surrounded by a distinct pale border.

3. Leptodontium recurvifolium Lindb. (*Bryum recurvifolium* Tayl.; *Didymodon recurvifolius* Wils., Schp. Syn.) (Tab. XXVIII. E.).

Taller and more robust than the last species, 1–5 inches high, pale or yellowish green above, dark or yellow below. Leaves from a pale erect base squarrose and recurved, slightly undulate; when dry crisped, undulate and incurved but *not erect nor appressed*;

rather distant, larger (*1 line long*) ovate-oblong or oblong-lanceolate, slightly narrowed above, at apex shortly and widely acute, or rather obtuse and apiculate; *margin plane*, serrulate from near the base, in the upper half with coarse irregular denticulations; nerve thin, *reaching apex and excurrent in a minute apiculus or slightly longer point;* basal cells rectangular, small, hyaline or pellucid, the upper rounded-quadrate, rather smaller than in the last, obscure with chlorophyll, minutely papillose, *2–4 rows at margin slightly enlarged, pellucid, smooth, forming a pale border, not papillose at edge.*

HAB. Wet rocks on mountains; very rare. Westmorland; South-west Ireland; Scotland; N. Wales. Fruit unknown.

A very fine and interesting species, and unknown outside our islands. Abortive archegonia mixed with a few paraphyses are the only organs of fructification that have been found. The plants are sometimes of a dusky colour, and almost black in the lower parts; more frequently they are pale yellowish green throughout, taller and more slender than the other form.

L. recurvifolium can hardly be confused with any other moss; in the dry state it might be overlooked for *Dichodontium pellucidum* or *D. flavescens*, but when moistened the recurved, squarrose leaves, with pale border, at once distinguish it.

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43. WEISIA Hedw.

Plants small or moderately tall, *slender*, with *lanceolate or linear-lanceolate* leaves, usually much twisted when dry, basal areolation hyaline, rectangular, upper small, almost always opaque and papillose. Fruit *small*, cleistocarpous, gymnostomous or peristomate, peristome when present of 16 *short*, more or less imperfect, entire or bipartite teeth, *erect*.

I have followed Lindberg and Braithwaite in uniting under one genus the species variously ranged under Systegium, Hymenostomum, Gymnostomum, Weisia, and Eucladium; but have separated under Trichostomum the more robust, distinct species usually placed under that genus, which have a very different habit, and for the most part a more highly developed capsule and peristome; while in the present genus there are few or none among the European species at least, except *W. verticillata*, with the peristome at all well developed.

The name Mollia (used by Lindberg and Braithwaite for this genus) must be rejected, as pointed out by Le Jolis (*Rev. Bry.*, 1895, p. 19), since it was employed in 1824 by Martius for a genus of Tiliaceae, for which genus it has been generally adopted and has been in use ever since.

Barbula exiguella Stirton (Ann. of Scot. Nat. Hist. No. 22, 1897, p. 120), Loch Harrie, Orkney, 1890, from an original specimen

is clearly a Weisia of the Eu-Weisia group. It is described as synoicous, antheridia having been only twice seen, "nearly in apposition to a germinating archegonium." I have dissected several of the fruiting plants, without finding the inflorescence synoicous or even paroicous, but one plant had a synoicous terminal flower with a male flower immediately below. The nerve is stout, 60-80 μ wide, and this would prevent its identification with *W. Wimmeriana* B. & S., the only European species with a similar (paroicous and polygamous) inflorescence. The capsules in Dr. Stirton's plant are entirely unformed. It is impossible without examination of ripe capsules to form a definite conclusion, but I am inclined to think it probably a form of *W. crispata* with here and there synoicous flowers.

DERIV.—After Weis, a botanist of Gottingen.

(There is considerable difference of opinion as to whether the name should be spelt *Weisia* or *Weissia*. The botanist appears to have employed both spellings—Weis and Weiss!)

1 { Capsule immersed ; lid very minute, persistent 2
  { Capsule exserted ; lid larger, deciduous 6

2 { Leaf-margin strongly involute above ..... *1. crispa*
  { Leaf-margin plane above 3

3 { Ls. strongly crisped when dry, lanceolate-subulate 4
  { Ls. less crisped when dry, oblong-lanceolate 5

4 { Cells opaque, perichaetial bracts much longer than the leaves ..... *1. crispa* var. *β*
  { Cells pellucid ; perichaetial bracts less distinct ..... *1*. sterilis*

5 { Seta much shorter than capsule ; perichaetial bracts long, sub-erect ..... *2. multicapsularis*
  { Seta as long as capsule ; perichaetial bracts few, divergent ... *3. Mittenii*

6 { Leaf-margin strongly incurved above 7
  { Margin plane or recurved above 10

7 { Nerve rarely 50 μ in width at leaf-base 8
  { Nerve 60-80 μ or more, reddish 9

8 { Peristome absent ; spores 18-25 μ ..... *6. microstoma*
  { Peristome present ; spores usually 14-18 μ ..... *8. viridula*

9 { Peristome absent, ls. often wide ..... *7. tortilis*
  { Peristome present, ls. usually narrow ..... *7*. crispata*

10 { Leaves toothed below, entire above ; plant glaucous ..... *14. verticillata*
   { Leaves entire, or crenulate merely with projecting cell-walls 11

11 { Nerve distinctly excurrent 12
   { Nerve vanishing in or below apex 15

12 { Capsule scarcely exserted, seta about $\frac{1}{2}$ line long ..... *4. rostellata*
   { Capsule well exserted on longer seta 13

13 { Peristome absent 14
   { Peristome present ..... *9. mucronata*

14 { Stem decumbent below ; ls. squarrose ; capsule olive-green with thin-walled cells ..... *5. squarrosa*
   { Stem erect ; capsule brownish when ripe, with firm-walled cells ..... *6. microstoma* var. *β*

15 { Stem very short; ls. lingulate, obtuse.....16
Stem usually longer; ls. more or less acute or sub-acute.....17

16 { Basal cells of leaves very long and narrow .....*10. tenuis*
Basal cells short.....*11. calcarea*

17 { Upper cells minute, opaque; nerve thick.....*12. rupestris*
Upper cells clear and pellucid; nerve slender.....*13. curvirostris*

A. SYSTEGIUM.

Capsules immersed, cleistocarpous; plants very small. Perichaetial bracts distinctly longer than the leaves.

1. Weisia crispa Mitt. (*Phascum crispum* Hedw.; *Systegium crispum* Schp., Syn.; *Mollia crispa* Lindb., Braithw. Br. M. Fl.). (Tab. XXVIII. F.).

Densely gregarious or sub-caespitose, pale or yellowish green, *2–5 lines high*, branched at the top. Leaves numerous, crowded, erecto-patent, when dry *strongly curled*, the lower small, gradually increasing in size upwards, linear-lanceolate, the comal, or perichaetial bracts *much larger*, 1½–2 mm., elongate-linear from a long concave whitish base, all rather concave, acute or slightly obtuse, *the margins very narrowly involute in the upper part*, nerve strong, excurrent in a short acute mucro, which is sometimes turned upwards so as to make the leaf apex somewhat cucullate. Cells at base lax, hyaline, rectangular; upper small, sub-quadrate, *opaque with chlorophyll and papillae*. Capsule *immersed* in the perichaetial bracts, on a very short seta, small, brown, sub-globose, with a distinct, minute, *conical-apiculate lid*, which, though not separating of itself, is easily removed. Calyptra cucullate. Spores 14–18 μ. Autoicous.

Var. β. *aciculata* Braithw. (*Weisia aciculata* Mitt.). More slender; perichaetial bracts tapering to a *longer, more acute* point, the margins often (though not constantly) *erect, not incurved*. Capsule almost sessile, concealed among the bracts; lid *shorter*.

Hab. On the ground; frequent. The var. β rare. Fr. spring.

Easily distinguished from all the Phascoid mosses with immersed capsules (except the next two species) by the long perichaetial bracts, cirrate when dry and forming the most conspicuous portion of the plant. The narrowly incurved margin in this plant has somewhat the appearance of a thickened border; but it is frequently very indistinct or the margin may be plane or erect in a few of the leaves, especially the lower, shorter ones; but some leaves will always be found showing the characteristically incurved margin.

In all the smaller species of Weisia with incurved leaf margins this variability occurs, and it will frequently be found that the margins of the

lower leaves are quite plane and those higher up the stem increasingly incurved, the perichaetial bracts always showing the greatest incurvation, which is, indeed, frequently confined to them.

From *W. multicapsularis* both it and its sub-species differ in the more crowded, longer, narrower leaves much more crisped when dry. From *W. sterilis* it differs in the more opaque areolation and involute margins of the leaves.

Hybrid capsules have been found in several localities between this species and *W. crispata*, and in one case between it and *Trichostomum flavovirens*.

* **Weisia sterilis** Nicholson (Journ. of Bot. 1903, p. 247) (Tab. XXVIII. G.).

Yellowish green; in dense tufts, larger and looser than *W. crispa*. Stems mostly branched, 4–8 lines high. Leaves small in lower part of stem, *above crowded, long*, to 3 mm. in length, *narrowly linear-lanceolate, margin plane or rarely slightly incurved; strongly crisped when dry*. Cells *less obscure and opaque than in W. crispa, somewhat pellucid*. Perichaetial bracts *little longer than and scarcely differing from the upper leaves*. Seta about half the length of the capsule. Capsule nearly spherical, lid with a *rather long, rostellate beak*. Autoicous; male flower at the base of the perichaetium.

HAB. On dry banks on the chalk downs from Lewes to Chichester (*Nicholson*); Reigate (*Nicholson*); Folkestone (*Dixon*). Fruit rare; February.

This plant has affinities with both *W. crispa* and *W. multicapsularis*, and owing to its plane-margined leaves, has been mistaken for the latter plant. It is, however, in structure and general habit more like the former species, from which, as well as from its var. *aciculata*, it differs in the much less differentiated perichaetial bracts, the more pellucid areolation, and the longer beak of the capsule. It also bears fruit much less often than either; indeed, its usual infertility is one of its most marked characters. The close strongly crisped narrow leaves at once separate it from the two following species. It more resembles *W. tortilis* and *W. crispata*, but the plane-margined leaves at once distinguish it. A continental species, *W. Levieri* Kindb. (*Astomum Levieri* Limpr.) is very closely allied, but our plant differs in the narrower, yellowish leaves with pellucid cells, and in the less developed lid.

W. sterilis is very definite in its preference for a chalky soil, while the allied plants of the group *Systegium* generally appear to avoid calcareous and prefer siliceous soils; this is especially noticeable with the two following species.

2. Weisia multicapsularis Mitt. (*Phascum multicapsulare* Sm.; *Systegium multicapsulare* Schp., Syn.; *Mollia multicapsularis* Braithw., Br. M. Fl.) (Tab. XXVIII. H.).

Taller and more slender than *W. crispa, 5-8 lines high* with longer, slender, flexuose, small-leaved branches; of a dingy green; leaves *wider, more distant, broadly lanceolate*, acute or obtuse, apiculate, spreading, flexuose and recurved, *margin plane;* upper leaves and bracts very long, *erect, less crisped* when dry, sub-

tubular above, but with the margins but little involute, tapering and acute, nerve rather narrower and less defined; areolation *slightly larger, more regular and quadrate, less obscure.* Capsule *immersed*, 1–1½ mm. long, with a rather longer, persistent lid. Seta very much shorter than capsule, not ⅕ its length. Spores 20–24 μ. Autoicous. Male inflorescence terminal, on a short branch, gemmiform.

HAB. On the ground in open spaces, rarely if ever on calcareous soil; rare. Fr. spring.

Distinguishable from *W. crispa* in the field by the dusky tint, the more slender stems and longer, small-leaved branches, the leaves and bracts much less curled when dry; the wider leaves with plane margins and different areolation are also characters of importance. *W. Mittenii* differs in the male inflorescence, in the more fragile leaves, and shorter, more spreading, fewer perichaetial bracts, with the capsule less deeply immersed on a much longer seta.

The specific name *multicapsularis* is misleading, as although two capsules may occasionally be found in one perichaetium, they are far more usually solitary. The name moreover is antedated by *Phascum sphaericarpon* Abbot, Flora Bedfordiensis, p. 230, as pointed out by Andrews (*Bryologist*, xxv, 70). But as that work dates from 1798, and is prior to the starting point for the nomenclature of mosses as decided at the Brussels Conference, I have not thought it proper to make the alteration.

This species has without doubt been confused with *W. crispa* var. *aciculata* on the one hand and *W. sterilis* on the other. The latter is quite different in habit, as well as in station, while the former is shorter, with narrower, more crisped leaves, and the margins less constantly plane or erect.

I do not find the nerve rough at back as described by Limpricht.

3. Weisia Mittenii Mitt. (*Astomum Mittenii* B. & S.; *Systegium Mittenii* Schp., Syn.; *Mollia Mittenii* Braithw., Br. M. Fl.) (Tab. XXVIII. I.).

Resembling *W. multicapsularis*, and scarcely I think distinguishable except by the fruiting characters; leaves fragile; the perichaetial bracts fewer, *shorter, divergent;* all flexuose when dry, not much curled; capsule *almost emergent*, sub-globose or very shortly elliptical, ¾-1 mm long, *seta about the same length;* ½ lid with a long, straight or slightly curved beak. Spores about the same size. Male inflorescence usually lateral, at the base of the fruiting innovation.

HAB. Roadsides and fallow fields; near Hurstpierpoint, Sussex (*Mitten*); Laughton and Barcombe, Sussex (*Nicholson*). Fr. spring..

The habit of this plant almost suggests a hybrid between *W. multicapsularis* and *W. rostellata*, but Mr. Nicholson thinks the conditions under which it grows do not tend to support the supposition. It forms, however, a distinct connecting link between Systegium and Eu-Weisia.

As in *W. multicapsularis*, here and there a leaf margin may be found narrowly involute.

The fewer, shorter, divergent bracts render the capsule much more apparent, but it is not really emergent, as it is entirely overtopped by the bracts; the seta is, however, much longer. I do not find any difference in the size of the lid between this and *W. multicapsularis*.

B. EU-WEISIA.

Capsules exserted, rarely cleistocarpous. Plants small; leaves curled when dry. Usually terrestrial. Autoicous.

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4. Weisia rostellata Lindb. (*Phascum rostellatum* Brid.; *Mollia rostellata* Lindb., Braithw. Br. M. Fl.; *Hymenostomum rostellatum* Schp., Syn.) (Tab. XXVIII. J.).

Very small, hardly a quarter of an inch high, dull green, densely gregarious. Leaves spreading, flexuose or recurved, crisped when dry, linear-lanceolate, *margin plane*, nerve excurrent in a short point; cells larger than in *W. crispa*, quadrate-hexagonal, incrassate, distinct, minutely papillose; at base rectangular, hyaline or pellucid, the marginal narrower and more hyaline. Perichaetial bracts hardly distinct. Capsule on *a very short seta, emergent or slightly exserted, hardly raised above the bracts*, shortly elliptical, brownish green; *lid persistent*, obliquely rostellate.

HAB. Muddy sides of pools, etc. Rare. Fr. winter.

This little moss fruits abundantly, and is, therefore, easily recognised, differing as it does from all our other species of the kind in the very shortly exserted capsules, which yet have the build of the more highly developed rather than of the species of the last section; from the preceding ones it differs also in the absence of distinct perichaetial bracts. *W. squarrosa* is hardly to be distinguished except by the more elongated seta and the deciduous lid.

The basal cells are sometimes hyaline, but at others coloured. The margins of the leaves are occasionally a little incurved, especially towards the point, so that the apex is slightly cucullate.

5. Weisia squarrosa C.M. (*Hymenostomum squarrosum* Nees & Hornsch., Schp. Syn.; *Mollia squarrosa* Lindb., Braithw. Br. M. Fl.) (Tab. XXVIII. K.).

Taller, $\frac{1}{4}$–$\frac{1}{2}$ inch in height, branched above, *finally decumbent*. Leaves distant, short, *squarrose*, upper longer, margin *plane or erect;* basal cells shorter. Seta *longer*, yellowish; capsule much resembling the last, but with a longer, *deciduous* lid; finally *olive green*, soft and thin in texture; cells of exothecium irregular, *with very thin walls*.

HAB. Fallow fields and banks. Not common. Fr. winter.

The longer seta, elevating the capsule considerably above the upper leaves, renders this plant easily distinguishable from *W. rostellata*, although it is closely allied to, and, indeed, in other respects hardly distinguishable from that species. It is also much like *W. microstoma*, but that species usually differs in the incurved margin of the leaves, which are less squarrose, and the time of fruiting is rather different. See, however, the note on that plant.

The first year's stem is very short, when the resemblance to the last species is accentuated; later on it developes innovations below the inflorescence, and the stem becomes decumbent.

6. Weisia microstoma C.M. (*Gymnostomum microstomum* Hedw.; *Hymenostomum microstomum* R. Br., Schp. Syn.; *Mollia microstoma* Lindb., Braithw. Br. M. Fl.) (Tab. XXVIII. L.).

Densely tufted, $\frac{1}{4}$–$\frac{1}{2}$ inch high, rarely more; deep green; stems *erect*, branched. Leaves spreading from a more erect, whitish base, much crisped when dry and glossy at the back, lanceolate, the upper longly linear-lanceolate, shortly pointed, mucronate with the excurrent nerve, concave, the margin *narrowly involute;* areolation minutely quadrate, opaque, papillose, at base rectangular, hyaline. Seta yellow, *longer* than in the last species; capsule oval, equal or slightly asymmetrical, *finally brown*, paler when empty, *mouth very small, the orifice closed with a membrane*, finally rupturing in the centre; cells of exothecium mostly elongated and rectangular, with the walls *firmer* than in *W. squarrosa;* lid obliquely rostellate, variable in length, but longer than in the last species. Spores 18–20 μ in diameter.

Var. β. *elata* B. & S. *Taller*, densely tufted; capsule *very small, hardly reaching above the elongated innovations.*

Var. γ. *brachycarpa* C.M., emend. Jur. (*Hymenostomum brachycarpum* N. & H.). Leaves often *broader*, margin *plane or only slightly incurved*, often more so in the upper bracts. Capsule often small and rounded.

Hab. Banks and barren ground, frequent. The var. β Ingleton; Merioneth; the vars. rare. Fr. spring.

Quite inseparable from *W. viridula* except by the fruit, which in that has smaller spores, and a wider mouth, not closed by a membrane, and presenting some traces, however indistinct, of a peristome. The thinner, more pellucid and delicate leaves, more tapering, and with narrow nerve distinguish it from *W. tortilis*.

I have dropped the var. *obliqua* C.M., the characters of which appear ill-defined; it is common if not usual to find slightly curved and asymmetrical capsules among plants of the typical form, and these, indeed, sometimes preponderate; a distinctly gibbous form of capsule, too, is not always correlated with the shorter lid described as characterising that variety.

The var. *brachycarpa* is a very perplexing plant. It was originally based on the short, sub-globose capsule, which is very marked in some of the continental specimens. Later on it was observed that the leaf margin in these forms was often plane or almost so, and this was rightly no doubt held to be a more important character than the form of the capsule. Still later,

there were found to be tall, robust plants with broad leaves having the margins sometimes entirely plane throughout the plant, with the capsule variable in shape, and not always in any way divergent from the type form. It is this plant which Juratzka has in mind in describing his *W. brachycarpa*, and it is certainly by far the most striking variety and the most removed from the type. I have, therefore, followed him and Limpricht in emphasising the leaf characters, while considering the form of the capsule of secondary importance, and feeling too some hesitation as to the propriety of retaining the original name. I have had several plants sent me as *W. squarrosa* which properly belong here, and in this light the recorded distribution of *W. squarrosa* in Britain certainly stands in need of revision; it usually has shorter, more squarrose leaves, but these characters may occur in the present variety; on the whole, the earlier time of fruiting, together with the less developed, greenish capsule, with thinner-walled, more irregular cells, less differentiated at the mouth of the capsule, are the best characters distinguishing *W. squarrosa*. I have seen plants however which are extremely difficult to determine and it must be admitted that the dividing line between these last three species is a very slender one.

7. Weisia tortilis C.M. (*Gymnostomum tortile* Schwaeg.; *Hymenost. tortile* B. & S., Schp. Syn.; *Mollia tortilis* Braithw., Br. M. Fl.) (Tab. XXVIII. M.).

More robust, more branched, bright or dull green above, *reddish below*. Leaves crowded, *wider* than in the last, narrowly oblong-lanceolate, *broadly pointed;* margin *widely* incurved; nerve *very stout, 60–80 μ or more*, rarely less than 50 μ, *yellow or reddish*, excurrent in a short mucro; cells at base rectangular, hyaline, passing rather abruptly and obliquely into the small, chlorophyllose, *very opaque, smaller* upper areolation. Capsule resembling that of *W. viridula*, but *gymnostomous*, with a small mouth only partially closed by a membrane which soon becomes inconspicuous. Spores 12–15 μ.

HAB. Calcareous rocks, banks, and walls. Rare. Fr. spring.

If due attention be paid to the characters italicised in the above description, there need not be much difficulty in recognising this species, for which forms of *W. microstoma* and *W. viridula* are frequently mistaken. It is a distinctly less delicate plant, with the leaves of a very opaque, solid texture, the borders more widely incurved, and the nerve much stronger and reddish; the plant, too, is usually of a lurid tint.

For the differences from *W. crispata* see below, under that plant.

The apex of the leaf is rather obtuse, but the margins are so much incurved that it frequently appears acute in outline until flattened out. Owing to their solidity the leaves are less strongly curled when dry, indeed the lower are only incurved, and it is the younger, uppermost leaves alone that are at all twisted.

The tufts frequently become detached, and quite free from their substratum.

* **Weisia crispata** C.M. (*Hymenostomum crispatum* N. & H.) (Tab. XXVIII. N.).

Resembling *W. tortilis* but more slender; leaves *narrower*, margins less widely enrolled; peristome present, *rudimentary, inserted below the orifice*, teeth of 2–3 articulations, pale, narrow, truncate, papillose.

HAB. In similar situations; not rare in limestone districts of England and Wales; Scotland; Ireland. Fr. spring.

I have given under *W. tortilis* and *W. crispata* the characters that usually mark and separate them from one another, but the peristome characters alone are absolutely reliable; *W. crispata* occasionally though rarely has the broad, widely enrolled leaves and stouter habit of *W. tortilis*, while slender forms of the gymnostomous plant undoubtedly occur, and may be called var. *subcylindrica* Schp., although it is probable that Schimper actually based his variety on *W. crispata*. *W. crispata* also fruits more freely than *W. tortilis*, which is frequently found barren; while the former, in Mr. Nicholson's experience of the two where they grow side by side in Sussex, does not share with *W. tortilis* the curious habit of detaching itself from the ground.

There can be no doubt that the great bulk of the plants recorded as *W. viridula* var. *gymnostomoides* belong here; whether there is actually also a variety of that species with equally rudimentary peristome is somewhat doubtful; I am inclined to think that it does exist, but so rarely that it may well be united with the var. *amblyodon* of the same species, which is in any case very near it.

The existence of the peristome as the only absolute distinguishing structural character separating *W. crispata* from *W. tortilis* is a strong argument against the unscientific separation of Hymenostomum from Weisia.

The student will not have any great difficulty in determining these plants with incurved margins, if he bears in mind that the broad nerve determines *W. tortilis* and *W. crispata*, the peristomate capsule *W. crispata* and *W. viridula*, while *W. microstoma* is also distinct from *W. tortilis* in the larger spores.

8. Weisia viridula Hedw. (*Bryum viridulum* L.; *Mollia viridula* Lindb., Braithw. Br. M. Fl.; *W. controversa* Hedw., mult. auct.) (Tab. XXIX. A.).

Resembling *W. microstoma*, but usually a rather larger plant, yellowish green. Leaves almost exactly as in that species, the upper elongate-linear, tapering to a rather narrow point, *margin strongly involute*. Capsule on a yellow seta of variable length (2–4 lines), oval or elliptical, narrowed at mouth, but not strongly contracted as in the above species, dull or reddish brown, *peristomate;* slightly sulcate when dry and empty; lid long-beaked. Peristome teeth very variable, often very imperfect and almost wanting, red, linear, cleft or entire, often truncate. Spores *14–18* μ in diameter.

Var. β. *amblyodon* B. & S. (*W. amblyodon* Brid.). Leaves *shorter, broader;* peristome teeth *short, truncate;* lid shorter.

Var. γ. *densifolia* B. & S. (*W. densifolia* Wils.). *Taller*, densely tufted, much branched; leaves narrow, *crowded*; seta *short*.

HAB. Banks and sandy ground; common. The var. β rare; the var. γ in mountainous districts; both rarer than the type. Fr. spring.

A somewhat variable plant, hardly distinguishable in many of its forms from *W. microstoma*, except by the wider-mouthed, peristomate capsule, and usually smaller spores; and it is sometimes difficult to find traces of the peristome even when present, so fragmentary and rudimentary its development occasionally is. As a rule however, it is a plant of rather freer growth and larger dimensions.

As remarked under *W. crispata*, the var. *gymnostomoides* may well be merged in the var. *amblyodon*.

The varieties of *W. viridula* have occasionally larger spores than the type, up to 22 μ.

9. Weisia mucronata B. & S. *Mollia rutilans* Lindb., Braithw. Br. M. Fl.) (Tab. XXIX. B.).

Very near *W. viridula*, but differing in the rather *wider* leaves, concave but with *plane* margins, nerve excurrent in a rather long mucro. Capsule narrowly oblong, slightly striate when dry; peristome teeth *broader*, *irregular*, *fugacious*. Spores much larger, *20–30* μ in diameter.

Var. β. *subgymnostoma* Limpr. Peristome *rudimentary*, scarcely appearing above the mouth of the capsule.

HAB. Clay banks in shady places. Rare. The var. β, Hamsey, Sussex (*Nicholson*); Derbyshire. Fr. spring.

The plane-margined leaves, slightly wider and more distinctly mucronate, and the larger spores, are really the only distinguishing characters by which this species may be known from *W. viridula*. According to Husnot, whose measurements of the spores is confirmed by my own observations, the statement made by Bruch and Schimper in the Bry. Eur., and copied by Wilson, that they are 2 or 3 times as large as in *W. viridula* is inaccurate, and is not borne out by Bruch's own specimens.

C. EUCLADIUM.

Plants usually taller; leaves more rigid and fragile, with a stout nerve, less crisped when dry. Rupestral. Dioicous. Capsule exserted, gymnostomous or peristomate.

10. Weisia tenuis C. M. (*Mollia tenuis* Lindb., Braithw. Br. M. Fl. ; *Gymnostomum tenue* Schrad., plur. auct. ; *Gyroweisia tenuis* Schp., Syn.) (Tab. XXIX. C.).

Very short, in wide mats, bright green above, hardly 2 lines high. Leaves very small, about $\frac{1}{2}$ line long, erecto-patent, slightly recurved, when dry erect, *hardly twisted*, rigid, fragile ; *ligulate, rounded and obtuse at apex*, margin *plane*, often crenulate with projecting papillae ; nerve rather strong, ceasing below apex. Basal cells rectangular, hyaline, *3–6 times as long as broad*, above shortly rectangular, at apex sub-quadrate and irregular, papillose, rather thick-walled, distinct ; perichaetial bracts larger, wider and sub-sheathing. Capsule on a short very slender seta, *gymnostomous*, *small*, narrowly oblong, red at mouth ; annulus broad, persistent ; lid *very short*, *conical-acuminate*. Male plants very short.

Hab. On inclined faces of sandstone or calcareous rocks ; not common. Fr. summer and autumn.

W. tenuis is known from all the other species (except *W. calcarea*) by the dwarf plants in neat patches of a deep green, and the small, ligulate leaves very rounded and obtuse at apex ; the leaves in *W. calcarea* are more frequently narrowed and shortly pointed, the basal cells shorter, the upper more obscure, the lid longer, and the whole plant as a rule taller. The period of fruiting appears to be extended and variable in *W. tenuis*.

A minute, undeveloped form of *W. verticillata* occurs, which may easily be mistaken for this species ; some leaves will however generally show a slight marginal toothing above the base.

11. Weisia calcarea C. M. (*Gymnost. calcareum* Nees & Hornsch., Schp. Syn. ; *Mollia calcarea* Lindb., Braithw. Br. M. Fl.) (Tab. XXIX. D.).

Resembling the last species but usually *taller*, $\frac{1}{4}$–1 inch, stems slender, branched, very densely matted, bright light green. Leaves crowded and much larger at the tip of the stem, resembling the last in form, but less rounded at apex and *often sub-acute ;* basal hyaline cells fewer, much smaller, *2–3 times as long as broad*, the upper more opaque and more strongly papillose. Capsule variable in form, lid *longer*, conical with an oblique rostellate beak.

Var. *β. viridula* C. M. (*Gymnost. viridulum* Brid.). Very short, *darker green ;* leaves *shorter, more obtuse ;* capsule *very small, ovate.*

Hab. Limestone rocks in shady situations ; very rare ; England ; Scotland ; Ireland ; Wales. The var. *β*, Yorkshire ; Wales ; Scotland. Fr. very rare, summer.

A very pretty, delicate moss, common in the Mediterranean region of the continent, rarer and mostly sterile further north ; very variable, but distinguishable from *W. tenuis* as above described, and as pointed out under

that species, and not much like any other moss in its leaf form and habit, though *W. rupestris* might be mistaken for it ; the latter is, however, a more robust plant, usually of a duller green and in taller, more swollen tufts, with more acute leaves.

12. Weisia rupestris C. M. (*Gymnost. rupestre* Schleich., Schp. Syn. et plur. auct. ; *Mollia aeruginosa* Lindb., Braithw. Br. M. Fl ; *Barbula incavata* Stirt., in Scot. Bot. Rev. i, 93) (Tab. XXIX. F.).

In compact, swollen tufts, ½ to 3 or 4 inches high ; dull olive green or more rarely deep bright green above ; stems slender, branched. Leaves crowded, often in interrupted tufts, erecto-patent or spreading and recurved, when dry appressed and lightly twisted, the uppermost more strongly so, but hardly curled ; small, *short*, oblong-lanceolate or linear-lanceolate, *shortly tapering*, sub-acute or obtuse, slightly concave, *plane or nearly so at margin*, which is crenulate with papillae ; nerve thick, reddish, becoming narrower and more indistinct near apex and lost at the point ; cells at base shortly rectangular, firm, hyaline, in all the rest of the leaf *small, quadrate-rounded, obscure, papillose*, incrassate. Seta rather short, *1–2 lines ;* capsule small, oval or narrowly elliptical, *thin-walled*, when dry and empty pale yellowish brown and glossy, with a reddish mouth, narrower than or equal to the width of the middle of the capsule, *gymnostomous ;* lid with an oblique shortly subulate beak, pale. Spores *small, 10–14 μ.*

HAB. Wet rocks, in limestone districts, locally abundant. Fr. late summer and autumn.

This species and the next are nearly allied, but *W. curvirostris* can be distinguished in the field by the leaves usually (but not constantly) more narrowly and longly acuminate, and by the capsules darker, firmer and more solid, on longer setae, the mouth usually wider than the rest of the capsule ; also by the longer, firmer, dark lid. Under the microscope the two are at once separated by the small, short, opaque cells of the present plant, and the plane margins of the leaves ; in the next species the cells are larger, often longer, almost empty, and clearly defined ; and one margin at least is recurved.

The taller, more luxuriant forms of *W. rupestris* are more frequently barren, and might be confused with *Zygodon Mougeotii*. The latter, however, has the leaves narrower above and more attenuated, the nerve narrower, the margin slightly recurved, and the cells usually much smoother. *Anoectangium compactum* has broader, more acute leaves.

W. rupestris is a highly variable moss in height, size, length and width of leaves, their degree of obtuseness etc. ; Mr. W. Ingham has gathered a tall, loosely growing plant at Wearhead, which may be referable to var. *intermedia* Limpr. Mr. Ingham has further recorded several other varieties as well as described some new ones, chiefly from Yorkshire and Durham ; but the variations appear to me at once too numerous and at the same time of scarcely sufficient value to be described at length. I have dropped the var. *ramosissima* also as being at least of no greater value than some of the other described varieties.

13. Weisia curvirostris C. M. (*Pottia curvirostris* Ehrh. ; *Barbula curvirostris* Lindb., Braithw. Br. M. Fl. ; *Gymnostomum curvirostre* Hedw., Schp. Syn. et plur. auct.) (Tab. XXIX. E.).

Resembling the last in habit, but more frequently of a paler green, in dense tufts often encrusted below with calcareous matter, fragile, 1–4 inches high. Leaves erect and hardly twisted when dry, *rather more narrowly tapering and acuminate, one or both margins recurved below*, nerve less strong ; cells at base pellucid, elongate-rectangular, above rectangular, elliptical and sub-quadrate, *larger, pellucid and distinct*, incrassate, more or less papillose. Seta *2-4 lines long ;* capsule ovate or rounded-ovate, rarely oblong ; *thick-walled*, glossy, dark reddish brown, after the fall of the lid *wide-mouthed and somewhat truncate ;* lid longly and obliquely subulate, *attached to the columella* and often persistent for some time ; peristome none. Spores *larger, 18–22 μ.*

Var. *β. commutata* Dixon (*Hymenostylium commutatum* Mitt.). Tall, brownish ; leaves long, narrow, more rigid, *the cells all elongated, smooth.*

Var. *γ. scabra* (*Barbula curvirostris* forma *scabra* Lindb. ; *Cynodontium asperellum* Stirt. in Ann. Scot. Nat. Hist. xv, 106). Leaves short, *broad, spreading and recurved ;* areolation *sub-quadrate, small, obscure with numerous papillae on the surface of each cell ; stem and back of nerve highly papillose.*

Var. δ. *insignis* Dixon (Journ. of Bot., 1902, p. 377). *Very tall and robust*, 3 5 inches high, dark green or brownish, not fragile nor encrusted. Leaves *long, loosely set, widely spreading from a wider, erect, sub-sheathing base.* Cells smooth on surface, papillose only by the projecting walls. Capsule *narrowly elliptic.*

Hab. Calcareous mountain rocks in damp situations ; frequent. The vars *β*, *γ*, more rare. The var. δ on dripping rocks in the Scotch mountains, Perthshire ; Argyllshire ; Sutherland ; Ben Bulben, Sligo. Fr. late summer and autumn.

The var. *commutata* has some claim to take a higher rank than a mere variety, the areolation in its typical or extreme form being very distinct. Intermediate forms, however, occur ; indeed, a fairly connected chain of forms exists from the above variety with its very smooth tissue and elongated, pellucid cells, through the *forma laeviuscula* Lindb., which may be looked upon as the type, with smooth stem, moderately papillose leaves, and shorter, but somewhat variable areolation, to the var. *scabra*, with the whole stem rough with papillae, extending up the back of the nerve, and the areolation short, quadrate, and papillose.

The var. *insignis* is a very distinct plant ; in addition to the characters described above, it has the stem rounded in transverse section instead of 3-angled as it is in the type ; on account of this and other points Dr. Hagen is strongly of opinion that it should constitute a distinct species ; I have, however, found the rounded stem and other characters in continental specimens of the var. *cataractarum* Schp., and I am inclined for the present to retain it as a variety. It is very different in habit and appearance from other forms of this species. The fruit has only once been found, on Ben Laoigh.

The points of difference between this and the last species are described above. *Anoectangium compactum* differs in the bright green soft tufts, with rather larger leaves more broadly pointed, and quite different areolation. *Zygodon Mougeotii* sometimes very closely resembles it; see under that plant.

14. Weisia verticillata Brid. (*Bryum verticillatum* L.; *Mollia verticillata* Lindb., Braithw. Br. M. Fl.; *Eucladium verticillatum* B. & S., Schp. Syn.) (Tab. XXIX. G.).

Densely tufted, ½–2 inches high, often encrusted with calcareous matter; *pale glaucous green* above, whitish below, stems very slender, fragile, much branched. Leaves erecto-patent, not much crowded, when dry appressed, hardly twisted, *long, linear-lanceolate or linear-subulate from a slightly* broader base, *acute or apiculate;* margin plane, *toothed just above the base* for a short distance; nerve *very broad*, occupying most of apex and excurrent in a mucro, or vanishing in the point; cells at base long, narrow (*5–10 times as long as broad*), thin-walled, hyaline, above rounded-quadrate, obtusely papillose. Seta reddish; capsule *oval-oblong*, thick-walled, *peristomate;* lid obliquely rostrate; *peristome teeth 16*, orange, flat, oblique, entire or divided.

HAB. Wet limestone rocks, more rarely on sandstone. Not uncommon. fruit very rare, summer.

Readily known by its glaucous colour, more slender stems, and narrower leaves; under the microscope the toothed basal margin is very characteristic and distinct. It is sometimes so thickly crusted with calcareous matter as to be quite hard and stone-like.

44. TRICHOSTOMUM B. & S. *emend.*

Plants for the most part *tall and rather robust;* leaves usually *narrow and elongate, with lax, pellucid, or hyaline basal cells*, and *minute, obscure, papillose upper areolation, curled and often strongly cirrate-incurved when dry.* Capsule oblong or cylindrical, *peristomate*, teeth *slender*, divided to or nearly to the base into two filiform divisions, more or less imperfect, or long, erect, oblique or contorted. Dioicous.

Although I have little doubt that Lindberg is right in combining with the species usually included under Trichostomum the plants belonging to the Section Tortella C. M. (of Barbula), as truly congeneric, it is with some hesitation that I have retained the generic name Trichostomum while including species the peristome of which in its structure exactly contradicts the definition of the genus as given by its authors. It has however,

always been admitted, even by the authors themselves, that the genus as so defined is an unsatisfactory one, added to which we have the fact that in some of the original species there is a distinct approach to a spiral twisting of the peristome; and I think it will be generally conceded that these considerations, together with the great undesirability of founding new generic names on old material, form sufficient justification for widening the definition of the genus to even this extent. The greater or less twisting of the peristome is only a question of degree; and its inadequacy as a generic character is obvious when it leads for instance to the separation of species so closely allied as *T. nitidum* and *T. tortuosum*.

The margin is plane or slightly incurved in all our species, never recurved nor strongly involute; by this character they may be known at once from certain species of Barbula and Weisia, which they otherwise somewhat resemble.

DERIV.—τριχο-(tricho) hair, and στομα (stoma) a mouth; alluding to the peristome.

1 { Basal hyaline cells ascending up margin of leaf....2
  { Basal hyaline cells not higher at margin than at centre....7

2 { Ls. recurved, upper cells pellucid....5*. *limosellum*
  { Ls. not recurved, upper cells more or less obscure....?....3

3 { Leaves wide, soft, obtuse, more or less cucullate at apex....4
  { Leaves narrower, not cucullate, more or less acute....5

4 { Leaves much curled when dry....5. *flavovirens*
  { More robust, leaves slightly twisted when dry....6. *inclinatum*

5 { Leaves rather rigid, straight, mostly broken across....6
  { Leaves flexuose, less fragile....8. *tortuosum*

6 { Leaves short with shortish points, strongly curled when dry...7. *nitidum*
  { Leaves with long narrow points, not or hardly curled when dry...9. *fragile*

7 { Nerve excurrent in a cusp or mucro....8
  { Nerve ceasing in apex....9

8 { Leaf-margin incurved at apex, more or less cucullate....1. *crispulum*
  { Leaf-margin flat or nearly so at apex....2. *mutabile*

9 { Leaves crenulate-notched at margin, scarcely dilated at base 3. *tenuirostre*
  { Leaves entire at margin, with dilated base....4. *hibernicum*

1. Trichostomum crispulum Bruch (*Mollia crispula* Lindb., Braithw. Br. M. Fl.; *M. scaphoidea* Stirt. in Ann. Scot. Nat. Hist. ix, 175) (Tab. XXIX. H.).

Densely tufted, tall or short, about one inch high usually, sometimes two inches; deep or yellowish green. Leaves crowded, *erecto-patent*, the comal rather more spreading, but usually incurved at apex, *not recurved*; when dry circinate-incurved, pale and glossy at back; *elongate linear-lanceolate, rather more than 1 line in length*, carinate-concave above, tapering to apex but not

acute, margin plane, *incurved at apex and forming with the upturned point of the nerve a more or less strongly cucullate or cymbiform tip ;* nerve yellowish, rather obscure above, vanishing or excurrent in a *very short* mucro ; margin *entire*, or very minutely and obsoletely denticulate above base ; basal cells pellucid, a few hyaline, small, narrow, rectangular, gradually becoming shorter and chlorophyllose, in upper part minute, quadrate, very obscure, papillose. Perichaetial bracts sub-sheathing, more acute than the leaves ; seta *reddish yellow ;* capsule oblong or oval-oblong, slightly plicate when dry ; peristome teeth *reddish*, rather short, unequally cleft, *papillose*.

Var. β. *elatum* Schp. *Tall, in large deep green tufts ;* leaves *broader*, more obtuse and cucullate at apex.

Var. γ. *nigro-viride* Braithw. *Tall*, very compact, stems *very slender, dark green, blackish below*. Leaves *small, short, narrow, concave and sub-tubular above* with the margins slightly incurved ; areolation dense.

Var. δ. *brevifolium* B. & S. (non *Tr. brevifolium* Sendtn.). In dense tufts, short, *slender*. Leaves crowded, *small, very shortly linear*, straight, *not or scarcely cucullate ;* nerve usually reddish.

Var. ε. *viridulum* Braithw. (*Tr. viridulum* Bruch ; *Tr. crispulum* var. *angustifolium* B. & S. ; vars. *angustifolium* and *longifolium* Schp. Syn.). In large dense cushions, *bright green* above, yellowish below. Leaves *longer*, linear-lanceolate, *tapering rapidly or gradually to an acuminate, often slender point, not cucullate*.

HAB. Calcareous cliffs, walls, and banks, especially near the sea ; not uncommon. The var. β rare ; the var. γ, Ingleboro, Yorkshire ; Derbyshire ; the var. *brevifolium*, Weymouth and Swanage (*Mitten*) ; Bredhurst (*Marten*) ; the var. *viridulum*, Babbicombe, Devon, 1866 (*Davies*) ; Vale of Llanthony, 1871 (*Boswell*) ; Pinhay Cliffs, Lyme Regis, 1904 (*Miss Lister and H. N. Dixon*). Fr. rare, spring and early summer.

This and the three following plants are readily known from the succeeding species and from *Pleurochaete* by the hyaline basal cells not extending higher at the margin of the leaf than at the nerve, but passing gradually and equally into the chlorophyllose areolation. *T. crispulum* is in its typical form easily distinguished from *T. mutabile* even with the lens by the narrower leaves with distinctly and abruptly cucullate apex, by their direction, which is always more erect and, perhaps, never distinctly spreading and recurved at apex as is frequently the case in the following plant ; the basal cells are also smaller and less hyaline, and the basal margin is almost always entire, rarely minutely denticulate, and never distinctly so as in *T. mutabile* var. *littorale*. It is probable that bearing these points in mind the student will not be likely to take plants of the true *T. crispulum* for any other species, though it must be remembered that there are forms of this plant with the leaves hardly cucullate, and others with wider leaves ; but as far as my own experience goes, I think it is usually safe to refer plants with narrow, tapering, erecto-patent, entire, shortly mucronate leaves, and

also plants with distinctly cucullate apex and entire margins, to this species, even though the former have the nerve straight and not upturned at point and the leaves consequently not cucullate, and though the latter have wider leaves more approaching *T. mutabile* in outline.

Mr. Holmes' specimens from near St. Ouens, Jersey, have the leaves toothed above the base, broadly lingulate or oblong in outline, and often decidedly obtuse in apex as in *T. mutabile* var. *littorale*, while on the other hand some of them have the apex distinctly, though not strongly, cucullate; this form appears to me to be more satisfactorily referred to the above variety, as it was, indeed, at first named by Mr. Holmes, though afterwards referred to *T. crispulum*.

I have had an opportunity of examining at the Kew Herbarium an original specimen of *Trichost. brevifolium* Sendtn. (Sutynska, Bosnia, 1847, coll. O. Sendtner), and of comparing it with Mitten's plant from Weymouth. Sendtner's plant is very marked in the strongly and widely enrolled margin of the leaves for the greater part of their length, rendering them very concave and indeed sub-tubular; this it may be remembered is the character upon which Limpricht chiefly relies as distinguishing it from *T. crispulum*. I do not however find this form of leaf in Mitten's plant. Here and there a leaf has the margins narrowly enrolled for some distance down, but in the main the incurving is confined to the apex and then only narrow and similar to that prevalent in *T. crispulum*. I am strongly inclined to consider our moss to be distinct from *T. brevifolium* Sendtn. (which appears to be a good species), and to be referable to *T. crispulum* var. *brevifolium* B. & S., which as Limpricht points out is quite another plant. Mr. J. Marten has sent me the same variety from Kent.

I have also only recently become acquainted with the var. *viridulum* (*T. viridulum* Bruch), which is certainly deserving of rank, being very marked not only in the form of the leaves but in the large tufts of a very brilliant green.

2. Trichostomum mutabile Bruch (*Mollia brachydontia* Lindb., Braithw. Br. M. Fl; *M. compressa* Stirt. in Ann. Scot. Nat. Hist. xviii, 172; *M. intumescens* Stirt., op. cit., xviii, 171) (Tab. XXXIX. I.).

In its typical form this differs from *T. crispulum* in its leaves *tapering to an acute point* with the margins *hardly or not incurved*, the nerve straight, *not upturned at point*, excurrent in a *longer*, distinct mucro, the hyaline basal cells more numerous and *wider*, the margins generally slightly undulate. The leaves, also, are usually more spreading at the top of the stem, often *slightly recurved* in their upper part. The size of the leaf is very variable, and the form of the apex is also subject to much variation, from slender and tapering to rounded, wide, and somewhat obtuse; the nerve is frequently slightly upturned at apex, and the margins slightly recurved. Seta *yellow*. Capsule oval-oblong or narrowly elliptical, sometimes slightly unequal; peristome *yellow*, *almost smooth*, short, more or less imperfect.

Var. *β. littorale* Dixon (*Trichostomum littorale* Mitt., Schp. Syn.; *Mollia littoralis* Braithw., Br. M. Fl; *Trichostomum episemum* Stirt. in Ann. Scot. Nat. Hist. xvi, 178). Leaves *wider and shorter*, more patulous and recurved above, *oblong-lingulate, rounded and more or less obtuse* at apex, margins plane

or slightly incurved at apex, *distinctly denticulate* at a short distance above the base.

Var. *γ. cophocarpum* Schp. *Taller*, red below. Leaves more erect, linear-lanceolate, *longer, acuminate and acute*. Capsule *short, oval;* peristome rudimentary.

HAB. Rocks and banks; frequent. The var. *β* in similar, more shaded situations; chiefly near the sea, frequent. The var. *γ* rare. Fruit rare, spring.

This species is subject to even greater variation than the last, and the slender-leaved form is very different in appearance from the extreme form of typical var. *littorale*, but I can see no adequate ground for giving the latter specific rank, seeing that the fruiting characters appear to be identical with those of *T. mutabile*, while intermediate forms of leaf-apex of every shade of obtuseness are found; the denticulate margin of the leaves below the middle is also sometimes to be found in the more typical forms of *T. mutabile*, though more strongly in the variety. Nor is the broad and obtuse apex by any means always correlated with shortness of leaf, usually given as a character of *T. littorale;* indeed, one of the most marked of the wide, obtuse-leaved forms is a very large-leaved plant usually found growing under hedges and on shady banks in the south.

In order to determine the degree of obtuseness of the leaves, it is necessary to flatten them out under a cover glass, as when viewed laterally or when slightly infolded at the edges an erroneous impression may easily be produced. It should be remembered, too, that in this and the allied species the leaf edges begin to roll inwards very quickly when the plant begins to dry, and it is necessary that the leaves should be thoroughly expanded before coming to a conclusion on this point. I have, moreover, often examined plants in which the margin at apex was in some leaves incurved, while that of others on the same stem was quite plane.

The mucronate apex of the nerve may be very slightly curved upwards, but never abruptly and markedly as in *T. crispulum*. The present is usually a more robust plant, and attains as much as three inches in height. *Barbula unguiculata* differs markedly in the recurved leaf margin.

After careful examination of original specimens of *Mollia lutescens* Lindb. (Braithw. Br. M. Fl., Vol. I., p. 246), gathered by Lindberg at Glena, Killarney, in 1873, I am obliged to confess I can find nothing in it beyond a rather marked form of *Trich. mutabile*. The leaves are indeed very long, but the variation in this respect is no greater than may well be considered within the limits of so variable a species; they also appear to be rather more fragile than usual, but this may partly be accounted for by age. In no other respect can I find the slightest difference from ordinary *Trich. mutabile*. The outline of the cells is not more distinct than is frequently the case in this species, nor are the cells themselves at all more pellucid, but exactly as I have frequently seen them in typical plants. Indeed, the areolation in *Trich. mutabile* is not really obscure, especially in mature leaves; the minuteness of the cells renders them somewhat difficult to distinguish unless highly magnified, but under a high power they appear quite distinct. I should be inclined to rank the plant in question under var. *cophocarpum*.

3. Trichostomum tenuirostre Lindb. (*Weisia tenuirostris* Hook. & Tayl.; *Didymodon cylindricus* B. & S., Schp. Syn.; *Mollia tenuirostris* Lindb., Braithw. Br. M. Fl.) (Tab. XXIX. K.).

In loose, *soft* tufts, ½–3 inches high, almost always yellowish green at least at the tips of the stems, yellowish brown or blackish

below; stems flexuose, slender or robust. Leaves fragile, *not densely crowded*, spreading and flexuose, when dry crisped, incurved and contorted, but *not closely circinate-incurved* as in the preceding plants, *less shining at back* on account of the narrower nerve; longer than in any of the foregoing species, *1½–2½ lines in length*, ligulate or narrowly linear-lanceolate, usually more tapering and ending *in a slender point*, but extremely variable in breadth and degree of acuteness of apex; margin plane, undulate, frequently somewhat sinuose above, *notched or irregularly dentate*, crenulate with papillae; nerve rather narrow above, *reaching to apex or vanishing;* cells at base rectangular, hyaline, rather wide, thin-walled, *gradually and not obliquely* passing into the shorter, chlorophyllose cells; upper areolation roundish-quadrate, larger than in the last, somewhat obscure. Seta *slender, yellow*, often two from the same perichaetium; capsule small, narrowly cylindric, pale brown; lid conical with a narrow rostellate oblique beak; peristome teeth short, slender, erect, irregularly cleft or perforated, fragile.

Var. β. *Daldinianum* De Not. Leaves *shorter, broader*, very acute, gradually tapering or suddenly apiculate, *with two marginal rows of cells incrassate, yellow, distinct;* capsule smaller.

Var. γ. *Holtii* Braithw. (*Mollia terrena* Stirt. in Ann. Scot. Nat. Hist. ix, 176). Robust, deep green above, *black below;* leaves *more crowded*, the upper ones sometimes slightly secund, more erect and straight, *wide, rather obtuse at apex, cells less papillose.*

HAB. Wet rocks by streams; not uncommon. The var. β in more alpine situations, rare; the var. γ by waterfalls on dripping rocks, not common. Fr. very rare, late autumn.

Although this plant bears some resemblance to *Trich. tortuosum*, that species may usually be known from the present by the paler colour, less lurid and less frequently yellow; the denser, longer leaves, and the habitat, which is usually drier, rarely in such humid spots; the latter point is also a mark of difference between *Tr. tenuirostre* and *Tr. mutabile*, which in some forms it occasionally resembles; under the microscope the distinction becomes clearer; the oblique ascending hyaline cells in *Tr. tortuosum* at once separating that species; while *Tr. tenuirostre*, though sometimes having straight, broad, shortly pointed leaves almost exactly resembling some forms of *Tr. mutabile*, will be recognised by the larger, less obscure areolation, the nerve not distinctly excurrent, and the margins strongly crenulate-denticulate, toothed or sinuose. It is also usually a more loosely tufted plant than that, with more distant and longer leaves. Some barren forms of *Diphyscium foliosum*, notably the var. *acutifolium*, might easily be mistaken for this plant, but are of a more rigid and solid texture, often with a reddish brown tinge, and with much more obscure areolation and nerve when viewed with the microscope. *Tr. hibernicum* has the leaves wider at the base, with more distinct, incrassate upper areolation.

4. Trichostomum hibernicum Dixon (*Tortula hibernica* Mitt.; *Mollia hibernica* Lindb., Braithw. Br. M. Fl.; *Barbula cirrifolia* Schp., Syn.) (Tab. XXIX. J.).

Tall, slender, in loose tufts, yellowish green, 2–4 inches high. Leaves *not crowded*, from a short erect sub-sheathing base flexuose-patulous or squarrose, crisped and incurved when dry; from a *wide, shortly oblong or obovate base gradually longly lanceolate-acuminate, tapering to an acute point*, 1½–2 lines long; margin *hardly undulate*, not dentate, very finely crenulate-papillose; nerve vanishing in the apex, or reaching just beyond; cells at base rectangular, hyaline, *rather suddenly* passing into the shorter, coloured upper cells, *not ascending higher at margin*; upper areolation small, *very distinct* (rather obscure in the young leaves), incrassate, subquadrate-rounded or shortly oblong-elliptic, faintly papillose; one or two rows at margin sometimes paler. Capsule cylindric.

HAB. Wet rocks; Killarney; Brandon Mt., Kerry; Ben Lomond, Perthshire; Glen Nevis. Fruit very rare.

A more slender plant than either *Tr. tenuirostre* or *Tr. tortuosum*, with smaller, more slender, less undulated leaves, expanded at the base, and more distinct areolation, the basal different from both. It is the *Anoectangium Hornschuchianum* of Wils. Bry. Brit.; but the true *A. Hornschuchianum* Funk (in Hoppe & Hornsch. Crypt. select.) has smooth leaves, very slender at the points, denticulate above the base, etc.

A somewhat perplexing plant has been found in Merionethshire with the leaf-base slightly expanded and somewhat intermediate in areolation between this and the last species, but on the whole I think it referable to *T. tenuirostre*.

A few old capsules only have been found, with the peristome too imperfect for description. The species has not been found outside Britain.

5. Trichostomum flavovirens Bruch (*Mollia flavovirens* Lindb., Braithw. Br. M. Fl.; *Barbula limosa* Stirt. in Ann. Scot. Nat. Hist. xiv, 106; *Mollia subbifaria* Stirt. op. cit., xviii, 241) (Tab. XXIX. L.).

Much resembling *T. mutabile* in habit, but softer, usually of a glaucous or yellowish green, the white base of the leaves very shining and distinct when dry, as is also the back of the nerve; leaves longer upwards (1–1½ lines), and crowded in a terminal coma, fragile, oblong-lanceolate or lanceolate from an erect, sheathing, hyaline base, *quickly narrowed* to an obtuse or shortly acute point; *concave, with the margin inflexed, especially at apex, which is sub-cucullate*, entire or faintly toothed at middle, verruculose above with projecting papillae; nerve strong, excurrent in a very short or slightly longer point; basal cells hyaline, thin-walled, *extending higher up the leaf at margins than at nerve*, passing abruptly into the chlorophyllose smaller ones, which thus terminate below obliquely, in a V-shaped line; the

upper *larger* than in any of the previous species, and less obscure, sub-quadrate or rounded-hexagonal, slightly papillose. Seta dark red below, yellowish above; capsule oblong-elliptic; peristome teeth *long*, filiform, papillose, dark red, erect or slightly twisted.

HAB. Sandy ground and banks near the sea; South of England and Ireland, frequent, but almost always sterile. Fr. spring, very rare; nr. Falmouth, and Fowey, Cornwall; Watermouth, Devon.

The remarkable basal areolation common to this and the remaining species amply distinguishes it from the foregoing plants; *T. nitidum* has more fragile leaves, more closely circinate when dry, less concave at apex, and more narrowly pointed; *T. inclinatum* is on the other hand at times almost inseparable without the fruit; but the leaves are usually closer, and less strongly twisted when dry, the stems taller.

I have gathered specimens with tapering, acute points, but they are uncommon. As a rule the wide points with strongly incurved margins are very characteristic.

* **Trichostomum limosellum** (Stirt.) Dixon comb. nov. (*Barbula limosella* Stirt. in Ann. Scot. Nat. Hist. xvi, 175.) (Tab. LXII. B.).

Extremely small and delicate, resembling *T. flavovirens* in miniature; leaves *recurved*; margins *plane*, not incurved above; apex *subobtuse*, *apiculate* with the excurrent nerve. Cells slightly larger, *pellucid*, *almost smooth*.

HAB. Seashore, Arisaig (Stirton). Fruit unknown.

On the whole I think this must be considered a sub-species of *T. flavovirens*, but it is a very marked plant, and readily distinguished from the smaller forms of that by the rather well defined characters italicised above.

6. **Trichostomum inclinatum** Dixon (*Tortula inclinata* Hedw. fil.; *Barbula inclinata* Schwaeg., Schp. Syn.; *Mollia inclinata* Lindb., Braithw. Br. M. Fl.) (Tab XXX. A.).

Intermediate between *T. flavovirens* and *T. tortuosum*. In *wide*, dense tufts, *yellowish green*, ½–1 inch high, stems *robust*, fragile. Leaves *crowded*, *erecto-patent*, *somewhat straight and rigid*, not enlarged at the coma, crisped at apex but not very strongly when dry, almost exactly resembling those of *T. flavovirens*, shorter than in *T. tortuosum* and much less narrowly tapering. Seta reddish; capsule oval-oblong, more or less curved; peristome teeth *long*, *spirally twisted*, *fugacious*.

HAB. Calcareous banks and rocks, usually in mountainous districts. Rare and sterile in Britain.

The leaves of this plant so nearly resemble those of *Tr. flavovirens* that the two species are very difficult to separate when barren; indeed, among

almost all the species of this genus there is so much variation and so much intermingling of allied forms, with very slight and perhaps deceptive fruiting characters, that hardly any arrangement or description can be quite satisfactory. Thus Boulay points out that the present species is connected with *Tr. tortuosum* on the one hand and *Tr. nitidum* on the other by so many intermediate forms that no very clear line can be drawn between them, and at the same time he makes the present plant a sub-species of *Tr. fragile*, indicating a still nearer affinity, in his opinion, to that species.

According to Limpricht, the structure of the stems differs in *Tr. flavovirens* and *Tr. inclinatum*, principally in the presence of a central strand in the former, which is absent in the latter. In undoubted *Tr. flavovirens* from our coasts, however, I find the central strand entirely absent, and the stem in section exactly similar to that of *Tr. inclinatum*. This species is usually taller, with the leaves very densely set, resembling *Tr. tortuosum*, but with shorter, much less tapering, straighter leaves, which are nearly erect when moist, and quite different at apex. I have, however, plants the position of which it is difficult to determine.

7. Trichostomum nitidum Schp. (*Tortula nitida* Lindb. ; *Mollia nitida* Lindb., Braithw. Br. M. Fl.) (Tab. XXX. B.).

In *neat, dense, rounded cushions, dull or lurid green*, dark below. Leaves *very fragile*, erecto-patent, slightly flexuose, crowded, when dry *rigidly circinate-incurved, very closely incumbent, the nerve very glossy and shining at the back ;* rather short, about 2 lines in length, linear-lanceolate, *shortly and acutely acuminate or more suddenly apiculate*, margin plane, slightly undulate, *not incurved at apex ;* nerve strong, greenish, brown in old leaves, excurrent in a very short mucro, prominent at back ; basal cells hyaline, passing *rather obliquely* into the shorter, more chlorophyllose cells, above small, rounded-quadrate, obscure, papillose. Capsule oblong-cylindric, peristome teeth short, rather imperfect, very slightly oblique.

HAB. Rocks and walls, almost always calcareous. Rare. Sterile in Britain.

The true position of this plant has been the subject of much discussion, upon which my slight acquaintance with the fruiting plant does not warrant me in pronouncing any opinion ; indeed, it is probable that it will remain more or less doubtful until an opportunity is afforded of studying the fruit in good condition and in greater quantity. Hitherto it has only been found in two localities, the two plants presenting certain differences of some importance in the structure of their fruit and peristome. Apart from the fruiting characters, moreover, *Tr. nitidum* exhibits certain variations in habit and vegetative structure which tend to ally it on the one hand to *Tr. flavovirens* and on the other to *Tr. tortuosum ;* and it is quite possible that ultimately it may be found necessary to unite it with one or the other. As far as I am aware, however, the variations in question do not occur, markedly at least, in this country, and the plant as we have it presents characters sufficiently distinct and constant to enable the student to identify it without much difficulty. It is usually more robust than *Tr. flavovirens*, less so than *Tr. tortuosum ;* but in habit it is more dense and rigid than either, usually growing in dense rounded cushions, the leaf-margin plane at apex, not incurved as in the former, the leaves very closely and neatly circinate-incurved when dry, so that the points are hidden, while in *Tr. tortuosum* and frequently in *Tr.*

flavovirens they are more or less spirally twisted upon themselves, in corkscrew fashion, less closely imbricated and with the points more or less projecting and visible. The nerve also is much more shining and glossy than it is (with at any rate very rare exceptions) in either, and the leaves more fragile. The var. *fragilifolium* of *Tr. tortuosum* most nearly resembles it, but is usually more loosely tufted and the leaves more narrowly pointed, less closely imbricated when dry, and less shining. *Tr. inclinatum* is known by the looser tufts, less fragile and less shining leaves, with concave, sub-cucullate tips. *Tr. fragile* is quite distinct in the leaves hardly curled when dry. *Tr. mutabile* is sometimes much like it in appearance, but the basal areolation is quite different, although the oblique transition of the basal cells is less marked in *Tr. nitidum* than in the allied species.

8. Trichostomum tortuosum Dixon (*Bryum tortuosum* L.; *Mollia tortuosa* Schrank, Braithw. Br. M. Fl.; *Barbula tortuosa* W. & M., Schp. Syn.) (Tab. XXX. C.).

In *tall rounded tufts*, small or extended, *1–4 inches high*, pale or yellowish green above, yellowish brown below. Stems *robust*, radiculose below; leaves rather crowded, fragile, *very long*, (*2–3 lines*), *spreading and flexuose*, when dry *strongly curled or spirally contorted on themselves*, the nerve pale and shining at back; from a pale whitish base longly linear, *tapering to a slender subula*, *undulate*, *margin flat at point*; nerve strong, pale, excurrent in a fine entire or slightly denticulate point; cells at base thin, rectangular, hyaline, reaching for some distance up the leaf and extending obliquely very high at the margin, abruptly becoming small, chlorophyllose, in all upper part rounded, rather large for the genus, less obscure than in some of the previous species, papillose, crenulate-papillose at margin. Seta long, red below, pale above; capsule shortly or longly cylindric, straight or slightly curved, lid rostrate, nearly as long as the capsule or much shorter; peristome very slender, *long*, *much twisted*.

Var. *β. dicranoideum* (*Mollia tortuosa* var. *dicranoidea* Ferg. MS., Braithw. Br. M. Fl.). Taller, compactly tufted, *densely radiculose nearly to apex*; leaves firm, *rigid*, *subsecund*, *the terminal ones collected into a cuspidate tuft*.

Var. *γ. fragilifolium* (*Barb. tortuosa* var. *fragilifolia* Juratz.). In *short small tufts*; leaves smaller, *shorter*, *less finely tapering*, *very fragile*, nerve excurrent in a yellowish point, *very glossy and pale at back when dry*; leaves when dry less strongly contorted, but more closely incumbent.

Hab. Rocks and mountain slopes, principally in calcareous regions, frequent. The var. *β*, very rare; North Wales; Scotland; the var. *γ* on exposed alpine rocks, walls, etc.; rare.

Very variable in height, length of leaves, etc., the smaller forms, and notably the var. *fragilifolium*, closely approaching *Tr. nitidum*, differing in the more slenderly pointed leaves, usually more laxly incurved when dry, and

of softer texture. At times, however, the distinctions seem almost obliterated, while on the other hand it is impossible to draw any clear line between the var. *fragilifolium* and certain other forms which connect it with the type by numerous intermediate links. I have, however, gathered a plant on Snowdon with exactly the dark small dense rigid cushions of *Tr. nitidum*, but in this case with the nerve hardly at all glossy at back. It is probable that the above variety and var. *rigidum* Boulay are not more than dwarf and somewhat starved forms induced by their habitat, which is usually on exposed mountain rocks. The leaves in this species are always more or less fragile, but they are of a much softer, less rigid texture than in *Tr. fragile*, and it may be noted that in our present plant it is usually the lamina that is torn, often leaving the nerve denuded (though the apex of the leaf, especially in var. *fragilifolium*, is often broken off), while in *Tr. fragile* the nerve itself is extremely brittle, and the rigid leaves are usually found snapped in half at or above the middle.

The robust stems, and longly linear or even subulate leaves, spreading and flexuose when moist, with very tapering points will generally serve to distinguish this species from all the foregoing ones; *T. hibernicum* being known by its more slender stems with laxer leaves expanded at the base as well as by the basal areolation.

The fruit is rare with us, and sparingly produced, ripening in summer; but unless gathered just at maturity it is very difficult to get good specimens showing the peristome.

A very remarkable plant with the leaves broadly rounded and obtuse at apex, from Glencoe, Argyllshire, was described in Rev. Bry. 1900, p. 36. It appears to be an abnormal form of the present species.

9. Trichostomum fragile Dixon (*Didymodon fragilis* Drumm.; *Barbula fragilis* B. & S., Schp. Syn.; *Mollia fragilis* Lindb., Braithw. Br. M. Fl.; *Barbula aggregata* Stirt. in Ann. Scot. Nat. Hist. vi. 120; *Mollia thrausta* Stirt., op. cit., xviii, 170) (Tab. XXX. D.).

In shorter dense tufts, bright or yellow green, resembling small plants of *Tr. tortuosum*. Leaves *erecto-patent, straight or very slightly flexuose*, scarcely undulate; when dry the mature leaves are usually *slightly arcuate, rigidly spirally twisted*, or rarely more strongly curled, but almost always more firm and less crisped than in the last, *very glossy and shining at the back*; either gradually tapering as in that species or more usually with the apex prolonged into a *capillaceous trigonous subula*, composed chiefly of the nerve, smooth or strongly papillose, *very fragile and broken off in all but the young leaves*. Nerve *broad, whitish*. Areolation as in the last, but usually rather more obscure. Capsule and peristome almost exactly as in that species.

HAB. Mountain rocks and sand-hills. Very rare, and sterile.

In its typical form this plant is at once known from the other species of the genus by its rigid, brittle leaves only slightly twisted and, indeed, sometimes almost straight and erect when dry, very narrow above and brilliantly shining at the back; when moist the straighter more rigid leaves distinguish it from *Tr. tortuosum*, and the elongate, subulate points from all other species. I have, however, received specimens from two or three localities in Labrador showing a distinct approach to *Tr. tortuosum*; the

leaves on some of the plants, and even the lower leaves on some stems in which the upper ones are quite typical, being strongly contorted when dry, crisped and undulate at the margin, and when moist slightly flexuose and undulate; hardly, indeed, to be recognised from the var. *fragilifolium* of *Tr. tortuosum* except by the leaves somewhat firmer, the very shining nerve and the presence (usually) of some rigid and less curved leaves. It is probable that this very curious and interesting species will be found to be allied by intermediate forms somewhat closely with *Tr. tortuosum*, as is undoubtedly the case with some of the other species of the genus.

The fruit has only been found in two or three continental localities.

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45. **PLEUROCHAETE** Lindb.

Leaves somewhat serrate or denticulate above, from a *sheathing* base; *hyaline cells at base marginal only, the median coloured*. Fertile flowers *axillary*. Peristome long, *slightly twisted*, papillose. Dioicous.

A very distinct genus both in general appearance and in structure, and, as Braithwaite remarks, with something the habit of Leptodontium.

DERIV.—πλευρο-(pleuro) side, and χαιτη-(chaete) a hair, bristle. From the lateral setae.

1. **Pleurochaete squarrosa** Lindb. (*Barbula squarrosa* Brid., Schp. Syn.) (Tab. XXX. E.).

Yellowish green, 1–2½ inches high, stems flexuose, loosely tufted, often scattered and mixed with other plants, branched. Leaves rather crowded, larger in the coma, *squarrose and flexuose from an erect sheathing base*; when dry strongly but not closely contorted, from the wide base quickly narrowed, lanceolate-acuminate, slightly undulated; margin plane, *finely denticulate above the base, near apex more distinctly and irregularly dentate*; nerve strong, reaching to or slightly beyond the apex; median basal cells small, short, firm, rectangular with rounded angles, pellucid, coloured; the marginal for several rows much larger, thin-walled, hyaline, abruptly passing into the median ones and *forming a very distinct hyaline band*, gradually narrowing upwards and reaching to or beyond the top of the sheathing base; upper areolation small, rounded-quadrate, rather obscure, finely papillose. *Perichaetia lateral*, the bracts numerous, with a longer, sub-sheathing base; seta long, red, paler above; capsule oblong-cylindrical, rather large, dark reddish brown; lid shortly rostrate; peristome red, fragile, forming about a single spiral turn.

HAB. Sandy and stony shores, and banks, usually near the sea, and chiefly in the South; not reaching further north than Lancashire. Rare and sterile. Fruiting on the continent in spring.

The squarrose tapering leaves from an erect and sheathing base, and the general straggling and rather untidy appearance of this moss, together with its accustomed habitat, make it an easily recognised species; and under the microscope the basal areolation is seen to be quite distinct from that of any other plant of the Order. The serrations are sometimes distinct, but are often too fine to be seen without the microscope.

Tribe 3. Cinclidoteae.

Plants robust, aquatic or riparian; leaves large, solid in texture, bordered. Capsule immersed or exserted. Peristome of 16 slender teeth bi-trifid above, more or less latticed below with connecting bars.

46. CINCLIDOTUS P. Beauv.

Characters those of the Tribe as given above. The fruit is sometimes apical, but typically cladocarpous, being produced at the extremity of short *lateral* branches. The aquatic species have a habit somewhat approaching Fontinalis, being dark-hued and long-stemmed, with long, blackish leaves. The European species are all dioicous.

DERIV.—κιγκλιδωτος (kinklidōtos), latticed; alluding to the latticed peristome.

{ Leaves densely papillose, with revolute margins; capsule exserted *1. Brebissoni*
{ Leaves faintly papillose, margin plane, capsule immersed...*2. fontinaloides*

1. Cinclidotus Brebissoni Husnot (*Tortula Brebissoni* Fior-Mazz.; *Barbula mucronata* Brid., Braithw. Br. M. Fl., Vol. I., p. 276; *Cinclidotus riparius* var. *terrestris* B. & S., Schp. Syn.) (Tab. XXX. F.).

Terrestrial, erect, in large soft tufts, 1–2 inches high, dark green above, blackish below, slightly branched. Leaves larger and more crowded at the summit of the stem, erecto-patent or spreading, *spirally twisted when dry,* especially the younger ones, *1–1½ lines long, broadly lingulate, rounded and obtuse,* shortly mucronate with the thick, excurrent nerve; *margin strongly revolute to apex, becoming united and thickened above;* cells at base hyaline, shortly rectangular, small, above *very small,* rounded-hexagonal, very chlorophyllose and opaque, *densely papillose on both sides.* Seta stout, *terminal,* yellowish brown, 3–5 *lines long;* capsule cylindric, rather large, narrowed at the mouth; lid rostellate or shortly rostrate; annulus none; peristome rather short, once twisted, teeth from a very narrow basal membrane, *red,* slender, papillose, fragile.

Hab. Rocks and stumps of trees by water. Not common. Fr. spring and early summer.

This species bears some resemblance to *Tortula mutica*; but that is of a more lurid, yellowish colour, with broader, spathulate leaves which are less twisted when dry, and which have the nerve hardly excurrent and less distinct at back, not conspicuously pale and shining as it is in the present plant. It is very nearly allied to *C. riparius*, with which it has been often united, but the seta in that plant is shorter, and thicker, the leaves are less twisted, indeed almost unaltered and appressed when dry; and under the microscope the plane margins and smooth cells easily distinguish it. There is no doubt as to the right to specific rank of the present moss, but it is not so clear whether it should be placed under *Tortula* or *Cinclidotus*, between which two genera it undoubtedly forms a connecting link. The structure of the peristome is that of *Cinclidotus*, and the slight twisting of the teeth, even were it peculiar to this species and not common to the others of the genus, cannot be held of importance, especially under the system of classification here adopted.

[Cinclidotus riparius *Arnott*, which has been included in our Moss-flora, msut be expunged. All the specimens so named have proved to be forms of *C. fontinaloides* with shorter, broader leaves than usual.]

2. Cinclidotus fontinaloides P. Beauv. (*Hypnum fontinaloides* Lamarck) (Tab. XXX. G.).

Aquatic, stems long and flexuose, 2–8 inches long, in large dense masses of a dull green or more frequently dark, almost black colour, *with short lateral branches*; the lower leaves usually worn away by the water so that only the stiff bristly nerves are left clothing the stem. Leaves long, more or less spirally twisted when dry and occasionally slightly so when moist, flexuose, often slightly secund, *narrowly oblong-lanceolate*, decurrent, *1½ to nearly 2 lines in length*, more tapering than in the two previous species, obtuse or shortly acute, but not acuminate, margin plane, strongly thickened to apex; nerve 60–170 μ wide at base, usually slightly excurrent in a short mucro, but occasionally vanishing at point; cells small, rounded-hexagonal, usually incrassate; small and rectangular, not much enlarged at the base. Upper cells *faintly papillose*. Fruit terminal *on short lateral branches, immersed* in the long, tapering, often secund perichaetial bracts or slightly emergent, seta very short; capsule ovate-oblong, bright reddish brown; lid acutely conical-rostrate, curved, red; peristome *purple-red*, twisted, long; the teeth filiform, branching above into two or three divisions, spirally twisted round the long, exserted, persistent columella.

Hab. Rocks and occasionally wood in streams, where frequently submerged; frequent; especially common on stones in mountain rivers. Fr. summer, but variable.

A very distinct, though somewhat variable plant, readily known by its dark colour with long, twisting leaves, and when fruiting, which it usually does abundantly, by the reddish brown capsules with strong red lid, which alone when the fruit is ripening protrudes from the perichaetium ; but after maturity the bracts become divergent, and the capsule slightly emergent, so as to be more conspicuous. *Grimmia apocarpa* var. *rivularis* and *Orthotrichum rivulare* both somewhat resemble it at first sight, and are often found in its company ; both however are quite different when more closely examined, the shorter, less flexuose leaves alone readily distinguishing them. *Cinclidotus riparius* is, as has been mentioned above, very close to some forms of it in growth and leaf structure, but the fruit is quite distinct.

When growing on the banks of lowland streams the black colour is more frequently wanting, the plant is more robust, with wider leaves of a dull green, less frequently secund. On the other hand Mr. W. Ingham has described a var. *pseudoaquaticus* with leaves narrow, tapering and acutely pointed, and strong broad nerve, bearing some resemblance to *C. aquaticus*, a continental species, which in habit closely resembles the present, but has longer, narrower, more decidedly falcato-secund leaves with a thicker nerve, and the capsule exserted on a seta almost equal in length to the perichaetial bracts. It has been recorded from a single locality in Ireland, but according to Dr. Braithwaite there is a doubt as to the accuracy of the record, which has never been confirmed.

ORDER X. ENCALYPTACEAE.

Erect, terrestrial or rupestral plants, usually caespitose. Leaves linear, lingulate or spathulate ; lower areolation thin, hyaline, fragile, the upper small, opaque with chlorophyll and strong verruculose papillae. Calyptra large, enclosing the whole capsule, campanulate or cucullate, capsule smooth or plicate. Peristome double, single, or none.

47. **ENCALYPTA** Schreb.

Capsule *erect, cylindric*, on a long seta. Calyptra *campanulate-cylindric*, inflexed at base when young, finally entire or ciliated ; not plicate ; *with a long straight beak ;* peristome extremely variable. Leaves as described above.

The plants of this genus are easily recognised not only by the form and areolation of their leaves, but especially by the large glossy, extinguisher-like calyptra, which persists until the fruit is quite ripe, and usually only falls with the lid when that separates. The peristome is in many species extremely fragile, in some quite absent ; in those species in which it occurs it presents very diverse and interesting characters ; in some few it is double, the outer teeth showing the characters of the Diplolepideae ; in others, where it is single, the teeth are constituted on the plan of some of the Aplolepideae belonging to Dicranaceae ; while in others,

again, they bear a nearer resemblance to those of Polytrichum, thus connecting the Order with the Nematodonteae. On the whole their true position appears to be at the meeting point of the Aplolepideae and the Diplolepideae, while at the same time there is a close and, indeed, remarkable resemblance between them and some of the species of Tortula, especially those of the Section Syntrichia, a resemblance which in the leaves is surprisingly close.

There is a great uniformity in the areolation of the leaves, and except in the case of *E. commutata*, which has smaller cells than any of the other British species, I do not think any reliance can be placed on the relative size of the cells ; Wilson, for instance, describes those of *E. vulgaris* as being larger than in *E. ciliata*, but some specimens of the latter have them distinctly larger than is the case with *E. vulgaris*.

DERIV.—ἐνκαλυπτω (enkalypto), to cover with a veil. Referring to the large calyptra.

1 { Ls. recurved, with tapering acumen ; cells about 10 μ.....*1. commutata*
  { Ls. with broader points, not tapering ; cells about 15 μ.....2

2 { Ls. obtuse, rather cucullate ; nerve scabrous at back near apex ; capsule with spiral striae.....*5. streptocarpa*
  { Nerve scarcely rough at back, usually excurrent.....3

3 { Calyptra fringed at base ; capsule smooth ; peristome present...*3. ciliata*
  { Calyptra not regularly fringed at base.....4

4 { Capsule with vertical striae ; peristome present.....*4. rhabdocarpa*
  { Capsule smooth ; peristome rarely present.....*2. vulgaris*

A. PSILOTHECA.

Capsule smooth or very indistinctly striate.

1. Encalypta commutata Nees & Hornsch. (*Leersia alpina* Lindb., Braithw. Br. M. Fl.) (Tab. XXX. H.).

Dull, lurid green, 1–2 inches high. Leaves *from an erect sheathing base slightly reflexed and squarrose*, appressed and incurved when dry, the upper twisted ; *broadly lanceolate-acuminate, acute*, cuspidate or almost piliferous with the excurrent, stout reddish nerve, slightly undulate, margin *plane ;* cells at base rectangular, hyaline, often coloured deep orange red, 3–5 times as long as broad, with 3–4 rows at margin longer, narrower, yellow, forming a distinct border ; upper cells *very small*, about 10 μ in diameter, rounded-quadrate or hexagonal-quadrate, obscure, crenulate-papillose at margin. Seta *red*, twisted ; capsule shortly and widely cylindrical, abruptly contracted at base with an indistinct neck ; bright brown, *smooth*, lid with

a long subulate beak ; mouth narrow, with a thin annular membrane, *peristome none*. Calyptra much longer than the capsule, *irregularly lobed or torn* at the hardly expanded base, *not papillose*. Autoicous.

Var. *β. imberbis* Lindb. Leaves *slightly cucullate at apex* with the incurved margins, *somewhat obtuse*, with the *nerve vanishing*.

HAB. High mountain rocks ; rare. Ben Lawers and others of the Breadalbane Mts. ; Ingleborough. The var. *β*, Ben Laoigh (*Holt*). Fr. late summer.

This species is at once known by its acute, tapering leaves, with smaller upper areolation, and smooth capsules. The calyptra, though less frequently fringed than in *E. ciliata*, is often considerably torn at the base. The leaves when pressed out under a cover-glass have a very distinct, almost panduriform outline, the margins just at the point of reflexing above the sheathing base usually becoming involute so that the leaf appears constricted in the middle.

As is usual in this genus, the papillose nature of the areolation causes the surface of the leaf to be dull, not glossy, when dry, but the excurrent nerve point is extremely bright and shining.

2. Encalypta vulgaris Hedw. (*Leersia exstinctoria* Leyss., Braithw. Br. M. Fl.) (Tab. XXXI. A.).

Short, less than ½-inch in height, deep or yellowish green, closely tufted. Leaves spreading, strongly twisted when dry, about 1½ lines long, elliptic-oblong, obtuse and rounded or more or less acute at apex, with the nerve vanishing or excurrent ; much narrowed at the base ; *margin plane*, very rough with verruculose papillae ; lower cells hyaline, rectangular, the marginal much narrower in a few rows, forming a border which is often yellowish ; the upper larger, more distinct and more pellucid than in the last (about 15 *μ*), hexagonal-quadrate, usually regularly seriate, very papillose. *Seta red*. Calyptra covering all capsule, incurved at base, which is *entire* or only shortly lobed, *scabrous* at apex and sometimes below. Capsule *smooth*, resembling that of the last, when dry and empty faintly plicate ; peristome *wanting or of short, very fragile and fugacious teeth*. Autoicous.

HAB. Walls and banks, frequent. Fr. late spring.

Many varieties have been described of this moss, chiefly founded upon the presence or absence of a peristome and the form of the leaf-apex. The former is, however, a most uncertain character, and its presence does not appear to be correlated with any particular form of leaf ; and as almost every degree of obtuseness and of acuteness is found in the latter, it does not seem worth while to found varieties on a single character which at best can be ill-defined ; the following are the most important forms :—var. *pilifera*, leaves terminating in a long cuspidate point formed by the lamina or the excurrent nerve ; var. *obtusifolia*, leaves rounded and obtuse, concave above, nerve vanishing ; var. *laevigata*, leaves apiculate, calyptra hardly papillose.

The peristome even when present is very difficult to find, being extremely fugacious, and it is probable that even when apparently wanting its absence is due, in some cases, at least, to the adhesion of the teeth to the interior of the lid, which carries them away when it separates.

When in fruit there is no difficulty in identifying *E. vulgaris*, the smooth capsule and entire calyptra separating it from all the species but the preceding which is quite different in the form of the leaves and areolation. *E. streptocarpa* is known by the nerve scabrous at back near apex, the longer leaves, and far more robust habit.

The nerve and cell walls at the base of the leaf are sometimes red; but not so highly nor so constantly so as in the other species.

3. Encalypta ciliata Hoffm. (*Leersia ciliata* Hedw.; *Leersia laciniata* Hedw., Braithw. Br. M. Fl.) (Tab. XXXI. B.).

About one inch high, bright green. Leaves rather large, 1½–2½ lines long, broadly lingulate or obovate-oblong, rounded at apex and apiculate, spreading; incurved and crisped when dry; slightly undulate towards the margin, which is *narrowly recurved about the middle*; nerve yellowish, rather glossy at back when dry, vanishing below the apiculus or excurrent in a short mucro; basal cells lax, hyaline, rectangular, with red walls, the marginal narrower and paler in several rows, *less distinct, however, than is usual in the foregoing species*; above, the cells are similar to those of *E. vulgaris*, opaque, with distinct pellucid walls, highly papillose. *Seta yellowish or pale red.* Calyptra straw-coloured, with an everted rim at base, *fringed with narrow, often spreading shreds, smooth* at apex. Capsule cylindric, greenish brown, finally pale reddish brown, *smooth, contracted below the mouth when dry*, with a short indistinct neck. *Peristome single*, teeth red, lanceolate, connivent or erect when dry, strongly incurved over the mouth of the capsule when moist. Autoicous.

Hab. Mountain rocks, not common. Fr. late summer.

E. ciliata is at once known by the smooth capsule, fringed calyptra, paler seta, etc.; the margin of the leaves is also usually recurved, though very narrowly.

There is considerable discrepancy between authors as to the peristome, some describing it as erect when moist, incurved and arched over the mouth when dry; others as connivent when moist, and erect when dry. As a matter of fact, I find on the same tuft mature capsules with the dry teeth inflexed, erect, or slightly spreading, in proportion to the degree of dispersal of the spores,- the more empty the capsules the more divergent being the teeth; all, however, becoming strongly inflexed, indeed flattened, over the mouth of the capsule as soon as moistened. I have never seen a specimen with the peristome of the very remarkable, if not unique, nature described by Schimper and Braithwaite, namely *becoming more patent* when moistened; indeed, one is tempted to suspect a slip of the pen.

It may be, perhaps, of some interest in connection with the above question to note that when once rendered inflexed by moistening, the teeth of the peristome, at least in my experience, do not regain their erect position upon drying.

The var. *subciliata* Warnst., with the base of the calyptra only slightly fringed and sometimes quite without fringe has been gathered by Stabler on Lion's Face, Braemar.

E. apophysata Nees & Hornsch., a continental species, differs in the longer paler capsule, with a more distinct neck, and with the teeth of the peristome paler, perforated along the median line, not entire as in our plant.

B. RHABDOTHECA.

Capsule ribbed or striate, longitudinally or spirally.

4. Encalypta rhabdocarpa Schwaeg. (*Leersia rhabdocarpa* Lindb., Braithw. Br. M. Fl.) (Tab. XXX. I.).

Densely tufted, ½–2 inches high, deep green. Leaves resembling those of *E. vulgaris*, but rather more narrow at the point; obtuse or acuminate, the nerve vanishing below the apex or excurrent in a mucro or short hair point; *areolation as in E. vulgaris*. Seta *red*. Calyptra rather short, *very little torn* at the base, *scabrous* above. Capsule *small*, oblong-cylindric, when mature brown, *with 8–16 reddish straight ribs*; when dry and empty narrowly cylindric, narrowest in the middle, very closely and deeply sulcate; apophysis distinct, wide when dry; *peristome single*, teeth short, pale, entire or bifid. Autoicous.

HAB. High mountain rocks, rare. Also on sand links at sea level, Caithness (*Rev. D. Lillie*). Fr. late summer.

The small, strongly ribbed capsule is quite distinct, and cannot be mistaken for that of any other species. The leaf differs widely from *E. commutata* in outline and areolation; from *E. ciliata* in the plane margins and less distinct areolation; it is known from *E. streptocarpa* by the more slender habit, smaller leaves, and smooth nerve. There appears to be no distinctive character by which the leaf can be recognised from *E. vulgaris*, but the habitat alone would almost always be a sufficient guide; *E. vulgaris* is however occasionally found in alpine situations.

5. Encalypta streptocarpa Hedw. (*Leersia contorta* Lindb., Braithw. Br. M. Fl.) (Tab. XXXI. C.).

Robust, 1–2½ inches high, densely tufted, dull or yellowish green; stems straight, *rigid*. Leaves spreading, when dry crisped, incurved and slightly twisted, *long* (*2–3 lines*), elongate-lingulate, often a little narrower in the middle than above and below, *obtuse or obtusely pointed*, undulate, margin plane, sometimes incurved and sub-cucullate at point; nerve thick, *vanishing below the apex*, *scabrous at back*. Areolation as in *E. vulgaris*. Perichaetial bracts acuminate, from an oblong base. Seta long, red; capsule long, cylindrical, with eight reddish *spiral* ribs; when dry spirally sulcate; calyptra very long, scabrous at

tip, laciniate at mouth. Peristome *double ;* outer teeth very long, red, filiform, papillose ; inner half the length of the outer, 32, pale, slender, filiform, adherent to the outer by their thin basal membrane. Dioicous.

HAB. Limestone banks and mortar of walls. Not uncommon, but exceedingly rare in fruit, which ripens in late summer.

This fine species is often abundant on the mortar of stone walls and bridges in our mountain districts, but almost always barren. It is much more robust and rigid than our other species, with longer leaves, which are more constantly obtuse, without any apiculus or excurrence of the nerve ; and the sharp papillae at the back of the nerve, which towards the apex usually point forward, and render it almost hispid, are found in no other of our species.

E. procera B. & S., a continental and American species somewhat resembling this but much rarer, is autoicous, with straight striae, and with the leaves more apiculate and with recurved margins.

SUB-GROUP II. DIPLOLEPIDEAE.

Peristome normally double, occasionally single, rarely wanting. When present each outer tooth consists of two layers of plates, the outer layer of two series divided by a vertical line, the inner of a single series extending across the width of the tooth, which, therefore, when viewed from the dorsal or *exterior* surface, presents a dividing line down the centre ; the ventral or interior surface, on the other hand, being without this division. The inner peristome when present is usually composed of thinner and more delicate tissue, consisting of two thin layers of plates, the external layer divided by 16 vertical lines, alternating with the outer teeth, the internal variously divided.

This Sub-Group contains by far the greatest number of the mosses, including the whole of the pleurocarpous species, and some of the most extensive Orders of the acrocarpous ones. Philibert has shown that the single peristome of the Aplolepideae is the homologue, not of the outer, but of the inner peristome of the Diplolepideae. It is, therefore, misleading to speak of the outer layer of teeth in the latter as the peristome and the inner as the endostome, a term occasionally used ; it would, indeed, be more in accordance with the actual facts to term the latter the peristome and the outer layer the exostome.

DERIV.—διπλο-(diplo) double, and λεπιδ-(lepid) a scale or plate.

** Diplolepideae Acrocarpae.*

Acrocarpous mosses, as in the preceding Orders, with a few rare exceptions. Stems erect, very rarely prostrate, branching frequently dichotomous.

In Anoectangium the fruit is truly pleurocarpous, but the plant is erect, the stems dichotomously branched, and the general habit quite that of the acrocarpous mosses.

Order XI. ORTHOTRICHACEAE.

Plants usually growing in short dense cushions; stems dichotomously branched. Leaves oblong-lanceolate or linear-lanceolate, usually very hygroscopic; cells more or less rounded-hexagonal, frequently papillose. Seta erect, often very short, capsule exserted or more frequently more or less immersed; erect, symmetrical, smooth or striate. Calyptra smooth and cucullate, or campanulate and plicate, often with erect hairs. Peristome double or single, rarely none; the outer teeth frequently united in pairs. Growing on rocks or the bark of trees.

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48. **ANOECTANGIUM** Schwaeg.

Tall, *densely matted plants;* leaves lanceolate, papillose, areolation small, opaque. *Perichaetia on the side of the stem;* seta long. Calyptra *smooth, cucullate.* Capsule *smooth, ovate;* peristome *none.*

A very curious genus, remarkable for the lateral fruit, a character which has given rise to much variety of opinion as to its true position; it is clear, however, that its natural place is among the acrocarpous mosses rather than with the true pleurocarps, and among these its affinity appears closest with Zygodon, although it very closely resembles some species of the genus Weisia.

Besides the single British species, several others are known, one of which, *A. Hornschuchianum* (now placed by Lindberg in a separate genus), was described as British by Wilson in the Bryologia Britannica, but the plant referred to proved—as Wilson suspected—distinct, and is the species described in the present work as *Trichostomum hibernicum.*

Deriv.—*ἀνοικτο-*(anoikto) open, and *ἀγγειον* (angion) a vessel; from the wide-mouthed capsule in some species.

1. Anoectangium compactum Schwaegr. (*Gymnostomum compactum* Schleich. : *Pleurozygodon aestivus* Lindb., Braithw. Br. M. Fl.) (Tab. XXXI. D.).

In *very dense* deep soft tufts, *pale vivid green* on the surface, bright brown below. Stems 1–4 inches high, very slender, *closely compacted* and interwoven with reddish tomentum. Leaves *small*, lanceolate or linear-lanceolate, acuminate and acute, strongly carinate, erecto-patent ; when dry closely incurved and slightly twisted : margin plane, minutely crenulate with papillae, towards apex entire or sometimes indistinctly waved or irregular ; nerve very prominent at back, green, vanishing at apex : areolation *very obscure*, papillose, quadrate-hexagonal, small, opaque, at base shortly rectangular, paler, more pellucid. Perichaetial bracts *sub-sheathing*, *shining*, not papillose : seta about ½-inch long, pale. Capsule elliptical-oblong, with a more or less distinct neck, pale brown with a shining reddish mouth, darker when old, rather glossy, thin-walled. Lid with a *very long oblique* subulate *beak*. *Peristome wanting*. Dioicous.

Var. *β. pellucidum* Anect. *pellucidum* Wils : *A. marinum* Stirt. in Ann. Scot. Nat. Hist. xviii. 244). More robust, with *larger*, *broader*, less carinate leaves more flaccid and less rigidly incurved when dry : *areolation larger*, *much more distinct and pellucid*, *smoother*, nerve rather narrower.

Hab. Shady siliceous rocks on mountains, not uncommon ; most frequently barren. The var. *β* rare, Scotch Highlands. Fr. summer and autumn.

A very distinct moss in its brilliant green colour and compact habit, forming large smooth soft cushions on the sides and in the clefts of damp rocks. The fruit is not uncommon, and when found is usually present in great abundance, the last season's capsules often being found side by side with those of the year, and almost or quite overtopped by the younger branches. *Zygodon Mougeotii* differs in the longer leaves, narrower in proportion to their length, *Weissia rupestris* in the duller colour, more obtuse leaves, and longer, more hyaline basal cells. *W. curvirostris* is quite distinct in the pellucid areolation, and recurved margin ; *Zygodon lapponicus* differs in habit, and in the smoother leaves as well as in the fruit. *Z. rupestris* in the habit, recurved leaves and shorter basal cells.

The var. *pellucidum* is very distinct in the areolation, but I have seen several plants intermediate between it and the type both in leaf form and cells.

The leaves are not strongly hygroscopic as is almost universally the case in this Order.

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49. ZYGODON Hook. & Tayl.

Stems slender, dichotomously branched, leaves from oblong-lanceolate to linear, *usually twisted when dry*. Capsule emergent or exserted on a longer seta, *8-striate*, with a distinct neck ; peristome *double*, *single or none* ; calyptra *smooth*, *cucullate*.

I have followed Bruch and Schimper and other authors in uniting *Amphoridium* with *Zygodon*. Although the sub-immersed capsules of *Z. lapponicus*, of a thicker consistency and with a wider mouth, give the plant a very different habit from that of the species with longer setae, it is only a question of a very slight shortening or lengthening of the seta; *Z. Mougeotii*, indeed, in this respect approaches the species usually included under *Zygodon*, and the differences resolve themselves into slight distinctions in the form of the capsule, hardly sufficient to carry generic rank when in so many particulars the plants are closely allied.

Zygodon is nearly allied to *Ulota* and *Orthotrichum*, differing principally in the smooth, cucullate calyptra, the oblique beak of the lid, and in the usually narrower leaves almost always with plane margins.

DERIV.—*ζυγο*-(zygo) united, and *ὀδους* (odous) a tooth, the teeth of the peristome being joined in pairs.

1 { Leaves toothed near apex.....*6. gracilis*
{ Leaves entire.....2

2 { Leaves wide, smooth, soft, hyaline at base; cells over 15 μ.....*5. Forsteri*
{ Leaves narrower, more or less papillose; cells under 10 μ.....3

3 { Stems tall, matted; ls. long and narrow; seta very short.....4
{ Stems short; ls. short; seta longer.....5

4 { Ls. much curled when dry; basal cells thin-walled.....*1. lapponicus*
{ Ls. scarcely curled; basal cells incrassate.....*2. Mougeotii*

5 { Nerve excurrent in a mucro.....*3*. Stirtoni*
{ Nerve vanishing below apex.....6

6 { Peristome absent; ls. spreading, recurved.....*3. viridissimus*
{ Peristome present; ls. patent, not recurved.....*4. conoideus*

1. Zygodon lapponicus B. & S. (*Gymnostomum lapponicum* Hedw.; *Anoectangium lapponicum* Hedw., Braithw. Br. M. Fl.; *Amphoridium lapponicum* Schp., Syn.; *Didymodon turgescens* Stirt. in Scot. Nat. ix, 35; *Zygodon teichophilus* Stirt. in Scot. Nat. xv, 36) (Tab. XXXI. E.).

Densely tufted, *dark olive green*, blackish below, ½–2 inches high. Leaves spreading, flexuose, *when dry curled and contorted*, oblong-lanceolate or linear-lanceolate, resembling those of *Anoectangium compactum*, but less papillose, and with slightly larger, rather more distinct areolation, the basal cells larger, *thin-walled*, more pellucid, or frequently hyaline, margin plane. Capsule on a *very short seta*, raised above or almost above the perichaetial bracts, oval with a distinct neck, *when dry contracted below the mouth and urceolate*, strongly 8-striate, *reddish above*, paler below, with a deep red, thickened rim; peristome none. Lid red, shining, with an oblique rostellate beak. Calyptra small, cucullate, brownish. Autoicous.

Hab. Clefts of rocks on mountains; not uncommon. Fr. summer.

When, as usually happens, the fruit is present in abundance, the striate, urceolate capsules, hardly emergent above the perichaetial bracts, cause the plant to be easily recognised. Even without fruit the small dense tufts of a dingy green, with the leaves strongly curled when dry, have a habit of their own not resembled by many mosses.

2. Zygodon Mougeotii B. & S. (*Gymnostomum Mougeotii* Bruch; *Anoectangium Mougeotii* Lindb., Braithw. Br. M. Fl.; *Amphoridium Mougeotii* Schp., Syn.) (Tab. XXXI. F.).

In large dense *yellowish* tufts, 1–3 inches high, brown below, or rarely blackish. Leaves erecto-patent or spreading, crisped when dry, *longly linear-lanceolate, tapering to an acute point*, carinate; margin towards apex entire or slightly irregular, hardly toothed, *narrowly revolute below*; cells narrowly rectangular at base, above shorter, subquadrate-rounded or very shortly rectangular, *all incrassate, pellucid, and hardly papillose*. Nerve rather strong, vanishing at apex. Capsule *very shortly exserted*, rather narrower than in the last, lid with a longer beak. *Peristome none*. Dioicous.

Hab. Damp rocks, frequent in alpine and sub-alpine districts; fruit extremely rare, ripened in autumn.

This species is not likely to be confounded with any of the other species of the genus, on account of its much longer, narrower leaves, which however vary somewhat in outline, and are occasionally much broader than in the type. It is more like *Weisia rupestris* or *W. curvirostris*; it has longer leaves than the former, and is almost always of a more decided yellowish tint; the more attenuated leaf points and recurved margins also separate it. The leaves are longer and narrower than is usual in *W. curvirostris*, and the basal areolation in that is usually thinner and more hyaline, but some forms may present considerable difficulty. The present species is rarely found on calcareous rocks. The fruit has hardly been found in half-a-dozen British localities. The seta is twice as long as in the last species, so that the capsule is quite exserted, and its height can have no value as a generic distinction between *Amphoridium* and *Zygodon*. The leaves are less twisted and curled when dry than in the last species, they are not at all glossy at the back, and hence the plant is in that state easily distinguished from the narrower leaved species of *Trichostomum*.

3. Zygodon viridissimus R. Brown (*Bryum viridissimum* Dicks.) (Tab. XXXI. G.).

In *small bright pale green* cushions or patches, ½–1 inch high; leaves *spreading and recurved*, twisted when dry, but not strongly; *oblong-lanceolate or narrowly ovate-lanceolate*, acuminate to an acute point, carinate above; margin plane, minutely crenulate with papillae; nerve narrow, pellucid, gradually becoming obscure and *vanishing usually at some distance below apex*; cells at base *very shortly* rectangular, somewhat rounded at the angles, incrassate; above rounded-hexagonal, *papillose*,

8–10 μ in diameter. Small clavate jointed gemmae are very commonly to be found on the leaves. *Seta 3-5 lines long*, pale; capsule small, oval-oblong or pyriform, 8-plicate, *contracted at the mouth*, pale yellowish brown; lid obliquely rostrate; peristome none or rarely extremely rudimentary. Dioicous.

Var. β. *rupestris* Hartm. (*Z. rupestris* Lindb.). Slightly more robust, darker green. Leaves *erecto-patent, not recurved, almost straight, narrower, ligulate-lanceolate.*

HAB. Trees, less frequently on rocks, common. The var. β on rocks and walls, rare. Fr. early summer; not commonly fertile.

A pretty little species, but rarely found in fruit. When dry the twisted leaves, the upper ones especially, become often turned to one side, giving a somewhat homomallous and distinct appearance to the plant. The apical cell of the leaf is often elongated, smooth and quite different in appearance from the lower cells.

The var. *rupestris* is a somewhat marked form, and is more or less intermediate between *Z. viridissimus* and the following sub-species. In addition to the above characters, Braithwaite describes the nerve as reaching nearly to the point, and the capsule as differing also from the typical plant; in fruiting specimens from rocks in Glenlyon, however, where the leaves are clearly those of the variety, the nerve ceases just as in the type, and the capsules also are quite typical.

There is a peculiar habit about the present species, both when wet and in the dry state, that makes it easy of recognition; the short, spreading and recurved leaves are especially characteristic.

For the differences from *Z. conoideus* see under that species.

*** Zygodon Stirtoni** Schp. (Tab. XXXI. H.).

Resembling the var. *rupestris* of the above, but with the *leaves less acuminate*, the nerve strong, *excurrent in a straight, thick mucro*, which is smooth or papillose, the lamina often ending unequally on the two sides. Capsule a little smaller and shorter.

HAB. Rocks and walls, principally near the sea; rarely on trees; not common. Fr. rare, spring.

Although this is usually a markedly distinct plant, yet intermediate forms are certainly to be found; and this fact, together with the existence of the var. *rupestris* above, must be held sufficient warrant for making the present a sub-species of *Z. viridissimus*, and not allowing it the full specific rank.

Clavate, jointed gemmae are generally found on the leaves and radicles of this plant, as they are also, but less constantly, on *Z. viridissimus*.

4. Zygodon conoideus Hook. & Tayl. (*Bryum conoideum* Dicks.) (Tab. XXXI. I.).

Resembling *Z. viridissimus* but *more slender;* leaves *smaller*, erecto-patent, *straight or almost so;* nerve a little more distinct; cells rather larger, more distinct, more strongly papillose. Seta very slender, as long as in that species; capsule *smaller*, with

a *longer, more distinct neck*. Peristome *double*, small and fugacious; outer of eight short obtuse teeth, in pairs; inner of eight delicate, fugacious processes. Dioicous.

HAB. Trees, rare. Fr. early summer.

According to Boulay, the characters, other than that derived from the presence of a peristome, are inconstant, and he makes *Z. conoideus* a sub-species of *Z. viridissimus*. It is to be remembered too, that very faint rudiments of a peristome have been found occasionally in the latter species. On the whole however, I have preferred to follow the usual arrangement and separate the two; not only on the ground that the presence of a well developed, double peristome, is a character of some considerable importance, but also on account of the general consensus of opinion, which is borne out by the specimens I have examined, in favour of a generally more slender habit on the part of *Z. conoideus*, a smaller capsule with more distinct neck, straight leaves, and larger and more distinct cells.

Malta has shown, further, that *Z. viridissimus* and *Z. conoideus* may be separated when sterile by the gemmae; in the former they are brownish when mature, short, 4-5 celled, clavate, broader above the middle; in the latter elongate, 5-7 celled, always green, and fusiform, widest about the middle.

5. Zygodon Forsteri Mitt. (*Bryum Forsteri* Dicks.) (Tab. XXXII. A.).

In small compact *dark green* cushions, about $\frac{1}{2}$-inch high or less, with pale-radicles below. Leaves erecto-patent, when dry very slightly twisted, *oblong-lanceolate or slightly obovate-spathulate, apiculate*, not carinate; margin plane, entire; nerve strong, reaching to the apex; basal cells lax, hyaline, rectangular, with thin walls, the upper hexagonal, or quadrate-hexagonal, *much larger than in the previous species*, 16–20 μ in diameter, deep green with chlorophyll and with highly pellucid cell-walls, *not papillose*. Seta *stout*, reddish brown. Capsule reddish or yellowish brown, *thick-walled, long-necked*, narrowly pyriform or oblong-pyriform, when ripe narrowed above, and *slightly contracted below the mouth*, when old becoming narrower, strongly eight-ribbed; lid shortly rostrate, oblique; peristome *double*, outer of 16 cleft teeth, which again are somewhat coherent two by two, strongly reflexed, inner of eight subulate processes. Autoicous.

Var. β. *Sendtneri* Dixon (*Euzygodon Sendtneri* Jur.). Leaves usually but not always narrower in outline; nerve *very stout, excurrent in a short but distinct stout mucro*.

HAB. Trunks of trees, very rare. Epping Forest.; Dorsetshire; Somerset. Recorded also for Sussex. The var. β, Burnham Beeches, Bucks., 1902 (*Nicholson*). Fr. summer.

A very pretty and interesting species, and no less rare than interesting. It has very little resemblance to the other species of the genus, and is perhaps more like an Orthotrichum, such as *O. pulchellum*, though it is hardly likely to be passed over for any other moss. The cells are twice as wide as those of any of the other species, and of a very clear and regular nature.

It is found on the continent, but never abundantly, and appears usually to confine itself to a single tree in each of its localities, as has been found to be the case in this country.

The var. *β* is a very marked form, with a striking development of nerve; it holds almost the same relation to the type that *Z. Stirtoni* bears to *Z. viridissimus*. The stout excurrent nerve is however the only reliable character, and I do not think the plant is entitled to a higher rank than a variety.

6. Zygodon gracilis Wils. (*Z. Nowellii* Schp., Syn.) (Tab. XXXII. B.).

In *wide* deep patches, 1–3 inches high, repeatedly branched, *dull brownish green above*, reddish brown above. Leaves spreading and recurved, when dry incurved, very little twisted, oblong-lanceolate, carinate, sub-undulate, slightly tapering to a subacute point; margin plane, *irregularly spinulose-dentate towards apex;* nerve narrow, vanishing in or below apex; areolation at base narrowly rectangular, incrassate, shorter at margin and sub-elliptic; above *very small, irregular*, quadrate-rounded or rounded-hexagonal, opaque, papillose. Seta *short*, reddish; capsule oblong-cylindric, *slightly inclined*, 8-striate; peristome double, resembling that of *Z. conoideus*. Dioicous.

HAB. Calcareous rocks and walls; very rare. North of England; Connemara, Ireland. Fruit very rare, summer.

A rare species, almost confined with us to the carboniferous limestone of West Yorkshire, and very different in habit from the other species, being a taller plant than most of them, while of looser growth than *Z. Mougeotii*, and of quite a different colour. Under the microscope, or even with the lens, it is at once known by its spinulose-dentate leaves.

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50. ULOTA Mohr.

Weissia Ehrh., (Braithw. Br. M. Fl.).

Usually growing in small rounded cushions, on trees, more rarely on rocks. Leaves lanceolate or linear-lanceolate *from a short ovate base, usually curled when dry; median basal cells very narrow, linear, incrassate*, coloured, marginal wider, hyaline in one or several rows. Capsule 8-striate, with a very long tapering neck, *exserted on a straight seta;* peristome single or double, outer of 16 whitish teeth, usually united in pairs, and more or less bifid, inner of eight or 16 narrow processes, alternate with the teeth, or wanting. Calyptra conical-campanulate, lobed at the base, frequently more deeply on one side, plicate, *usually covered with numerous erect yellowish hairs. Ochrea none or indistinct.* Stomata on the neck of the capsule.

The species of this genus are as a rule easily recognised by their neat rounded cushions usually abundantly fertile, with the leaves in most cases strongly curled when dry, and with the calyptra strikingly hairy. They are most common on the stems and branches of trees in sub-alpine woods, especially near streams. The different forms are somewhat difficult of determination; in part because the leaves offer few or no points of distinction between several of the species, partly because the differences in form of the capsules, on which certain of the species have been to a great extent founded, are somewhat slight, and are subject to some amount of variation. As a rule, the capsules chosen for examination should be fully ripe, dry, and empty, but not old. Special care is also necessary, because two species are very frequently found growing in the same tufts. The capsules are very persistent, and three years' fruits may often be found on the same tuft, in different stages of development.

I have used the term processes rather than cilia (the term by which they are known in most works) in describing the inner peristome of Zygodon, Ulota, and Orthotrichum, as they are in no way homologous with the cilia, as these exist in the peristome of Bryum and other highly developed forms, but rather with the true processes, being alternate with the outer teeth.

DERIV.—οὐλοτη (ulotē) something curled, from the curled leaves when dry.

1 { Ls. tipped with brown jointed gemmae.....*6. phyllantha*
  { Ls. not gemmiparous.....2

2 { Rupestral; ls. scarcely twisted when dry; cells small, very incrassate *7. Hutchinsiae*
  { Arboreal; cells less incrassate.....3

3 { Capsule inflated, pyriform, only striate at the contracted mouth *1. Ludwigii*
  { Capsule deeply striate throughout its length.....4

4 { In rounded tufts; ls. crisped when dry.....5
  { Stems often creeping; ls. less twisted.....*2. Drummondii*

5 { Calyptra densely hairy.....6
  { Calyptra with few hairs; ls. furrowed near base.....*5. vittata*

6 { Capsule short, wide-mouthed when dry and old.....*4. crispa*
  { Capsule longer, contracted at mouth finally.....*3. Bruchii*

1. Ulota Ludwigii Brid. (*Orthotrichum Ludwigii* Brid.; *Weissia coarctata* Lindb., Braithw. Br. M. Fl.) (Tab. XXXII. C.).

In small loose tufts, the stems decumbent below, sometimes slightly creeping, dull green or brownish. Leaves erect, when dry *lightly twisted but not strongly curled;* from a short ovate concave base narrowly lanceolate, rather shorter than in *U. Bruchii* and *U. crispa*, gradually tapering to a rather obtuse point; margin plane or variously recurved, entire; nerve narrow,

vanishing below the apex, reddish ; upper cells small, rounded-elliptic, very incrassate, slightly papillose ; basal near the nerve narrowly linear-vermicular, highly incrassate, yellowish green or orange ; becoming wider as they recede from the nerve, shortly elliptical-rectangular ; at margin short, rectangular, hyaline, thin-walled, forming a narrow hyaline band narrowing upwards to the top of the leaf-base. Capsule *pyriform, pale whitish brown, thin-walled, smooth, plicate only for a very short distance below the small, much contracted mouth ;* calyptra hairy ; lid rostellate ; outer peristome teeth united in pairs, erect when dry ; inner imperfect or wanting. Autoicous.

HAB. Young trees in mountainous woods ; rare. Fr. late summer and autumn.

Known at once by the inflated appearance of its obovate, pyriform, smooth, and almost glossy capsules, with the striae so short as to be barely perceptible, and by the strongly contracted mouth.

2. Ulota Drummondii Brid. (*Orthotrichum Drummondii* Hook. & Grev. ; *Weissia Drummondii* Lindb., Braithw. Br. M. Fl.) (Tab. XXXII. D.).

In larger tufts or wide patches, *the marginal stems decumbent and sometimes longly creeping*, with erect branches ; yellowish green, often reddish. Leaves rather longer than in the last species, *only slightly twisted when dry*, erecto-patent when moist. Capsule *oblong or clavate with a long tapering neck, large*, thick-walled, reddish with the neck paler ; broadly striate to base of capsule, and more faintly on neck ; when dry and empty the capsule becomes narrower, *elongate-fusiform, contracted at and sometimes below the mouth*, deeply sulcate from the mouth to the base of the neck, the striae sometimes slightly spirally twisted ; cells of exothecium *small*, 10–20 μ wide, stomata *small*, about 30 μ wide, in *numerous* (4-6) rows ; lid with a straight subulate beak ; calyptra variously hairy ; peristome *usually single*, of 16 white, *lingulate, somewhat irregular* teeth reflexed or spreading and recurved when dry ; occasionally rudimentary inner processes are present. Autoicous.

HAB. Young trees in mountainous districts, frequently growing in company with, and mixed with the last species, and with *U. Bruchii ;* rare. Fr. late summer and autumn.

When growing freely the creeping stems are very characteristic, and produce a resemblance to the important exotic genus *Macromitrium ;* frequently however this feature is by no means conspicuous, and then the species is difficult to separate from *U. Bruchii*. The capsule in the present species is rather larger, and in my experience of a rather brighter, more reddish tinge. The striae in *U. Bruchii* are also straighter and less frequently spirally oblique.

The most conspicuous differences however, and I believe constant and important ones, lie in the peristome and the structure of the exothecium. In *U. Bruchii* the teeth are much broader at the base, and usually contiguous, more regular and entire in outline, while in *U. Drummondii* they are narrower, somewhat distant, and often very irregular above. The cells of the exothecium are much smaller than in *U. Bruchii*, the stomata much more numerous, in several rows, and markedly smaller.

The time of fruiting is often given as a differentiating character, but authorities are much at variance as to this; *U. Bruchii* may as a rule ripen its fruit a shade earlier, but in my experience no reliance can be placed upon it.

Both this species and the preceding are much more abundant in N. America than with us; *U. Ludwigii* indeed appears in some parts almost to replace some of our commoner species.

3. Ulota Bruchii Hornsch. (*Weissia Bruchii* Lindb., Braithw. Br. M. Fl.) (Tab. XXXII. E.).

Much resembling the last species, but in rather more compact tufts, the stems *less prostrate and creeping; the leaves more curled when dry*, though less so than in the next species; the capsule usually of a duller colour, rather narrower, *when dry and empty distinctly fusiform, much contracted at the mouth*; cells of exothecium *large*, 18–35 μ wide, stomata *much less numerous* in *fewer* (2-3) rows, *large*, about 35–40 μ wide. Peristome *double*, inner of eight or 16 processes; outer teeth *wide*, narrowing upwards *from a broad base*, more regular and perfect in outline. Lid with a rather long beak.

Hab. Trees, rarely on rocks, frequent. Fr. late summer and autumn.

As above stated, this is at times a difficult plant to recognise from the last, though the leaves are perhaps always more curled when dry, while in *U. Drummondii* they are very slightly twisted, and in some cases almost straight. The presence of inner processes is a very uncertain character. I do not find any reliable distinction in the hairiness of the calyptra. The characters drawn from the structure of the capsule as described above, will always, I believe, distinguish them.

U. Bruchii may be readily known from *U. crispa* and its allies by its greater robustness, the colour usually, though not always, of a darker and duller green, often reddish, its longer leaves less closely and less strongly curled when dry, its capsule on a longer seta, and much larger, usually at least twice as long as in *U. crispa*, of a firmer texture, and of quite different form, never contracted below the mouth as in that species, and usually, especially when dry and empty, distinctly narrowed to the mouth, which is very small, so that the whole capsule, including the neck, has a narrowly fusiform shape. Starved specimens, however, are sometimes much like *U. crispa* var. *intermedia*. The areolation is a little larger than in those species, but the difference is hardly enough marked to determine specimens in the absence of other available characters.

4. Ulota crispa Brid. (*Bryum crispum* Gmel.; *Weissia ulophylla* Ehrh., Braithw. Br. M. Fl.) (Tab. XXXII. F.).

In *small dense round cushions*, bright green or yellowish. Leaves as in *U. Ludwigii* but rather longer, with a *wider band of hyaline cells* at each side the expanded base, *when dry strongly*

and closely curled. Seta and capsule shorter than in the last; calyptra very hairy; capsule when ripe and after the fall of the lid pale green or whitish brown, thin-walled, *smaller than in the last, sub-urceolate, distinctly contracted below the mouth,* then wider, and rather suddenly narrowing into the neck; becoming darker when old, and narrower; ribs narrower than in *U. Bruchii;* lid with a shorter beak than in that species; peristome teeth in pairs, so as to appear eight in number, at first spreading, afterwards recurved; processes eight, rarely 16. Autoicous.

Var. β. *intermedia* Braithw. (*Ulota intermedia* Schp., Syn.) Resembles the type in everything but the capsule, which, when ripe and empty is in the dry state *oblong-cylindric, of the same width throughout, not contracted below the mouth,* rather more gradually tapering to the neck, usually a little larger and of slightly firmer texture.

Var. γ. *crispula* Hamm. (*Ulota crispula* Bruch). *Smaller, leaves shorter.* Capsule *very small,* oval or sub-globose, with a long neck; *when dry and empty very pale and thin-walled, somewhat turbinate, wide-mouthed and not or hardly constricted below,* rather abruptly narrowed into the neck.

HAB. Trees; common especially in damp mountainous woods. The var. β often mixed with the type and apparently equally common. The var. γ in similar situations but rare.

A very pretty moss, its neat rounded cushions usually covered with capsules; these vary much in size, form and texture, and their shape depends much upon their age and upon the degree of moisture; before the fall of the lid they are green, oval, and suddenly contracted into the long tapering neck; but when they become perfectly matured, and are emptied of their spores, they are when dry narrower, paler, and contracted below the mouth; after maturity they undergo another change, growing darker in colour, and narrower, often becoming finally narrowly cylindrical or fusiform; in the early stages, as well as in the later, they are difficult to distinguish from some of the other species, and dry, well ripened, but not over-ripe capsules should be chosen for examination.

If good typical tufts of *U. crispa* and the var. *intermedia* are examined, the difference in form of the capsules is very marked, the latter being in no way urceolate, but exactly of the same width at the mouth as below. It is, however, comparatively rarely that perfectly typical capsules of either are met with; this being especially the case with the var. *intermedia;* on the contrary, more often than not, some at least of the capsules on a tuft show a very slight contraction below the mouth, while on the other hand the typical, distinctly urceolate form of capsule of *U. crispa* is less frequently met with than a somewhat less distinct form, markedly but less strongly constricted. It is impossible therefore to maintain *U. intermedia* as an independent species, and it should perhaps be looked upon rather as a variety only. Similar remarks apply to the var. *crispula,* and the two varieties may in some degree be considered as the two extreme limits, the one more robust, the other more slender, of a fairly well graduated chain of forms of which the type occupies the middle position. On the other hand forms referable to the var. *crispula* in size of capsule, general slenderness, etc., sometimes in the shape of the capsule resemble the var. *intermedia* rather than the type, and thus establish a separate chain of forms.

In the var. *crispula*, as the fruit becomes old the capsule narrows, the transition to the neck becoming less abrupt, until finally the whole becomes narrowly oblong, or gradually tapering from the mouth to the neck, and in these states the resemblance, in miniature, to the var. *intermedia* is very pronounced. I have indeed seen on the same tuft capsules exhibiting a great variation in size, some of which would be quite inseparable from the var. *intermedia*. In some parts, at least, of Canada, judging from numerous specimens I have received, the two varieties would appear almost to supersede the type.

5. Ulota vittata Mitt. (*Ulota calvescens* Schp.; Handb., Ed. 2; *Weissia vittata* Braithw., Br. M. Fl., Vol. II., p. 95). (Tab. XXXII. G.).

Resembling *U. crispa* in habit. Leaves with an *oblong* (not widely oval), *less dilated base*, which has *a deep narrow furrow on each side* close to the margin, often longer on one side of the leaf than the other; *basal cells all narrowly linear or vermicular except 1–2 rows of rectangular hyaline cells at margin;* the narrow cells are also continued high up on each margin, only very gradually passing into the short, rounded-elliptical cells of the upper part, so that even above half-way up the marginal cells in 3–5 rows are distinctly longer and narrower than the median ones. Calyptra *pale, glossy, with a very few scattered hairs*. Capsule on a *rather long* seta, resembling much that of *U. crispa* var. *intermedia*, oval-oblong with a distinct neck, of rather firmer texture and more highly coloured, when ripe and empty hardly contracted either at or below the mouth; when old rather fusiform and frequently narrowed below the orifice; rather less deeply sulcate than in the last species. Peristome double. Autoicous.

Hab. On shrubs and young trees; rare. On a sandstone wall, Connel Glen, Fermanagh (*Lett*). Fr. summer.

This species differs not only in the almost glabrous calyptra, but also markedly in the form and structure of the leaves; the deep fold or vitta (whence the specific name *vittata* of Mitten), the narrower base, the absence of the wide bands of hyaline cells, and the band of elongated cells extending high up the margin of the leaf, all afford clear distinguishing characters. The seta is also distinctly longer for the size of the capsule than in the allied plants, and the fruit is rather more sparingly produced. It has been found in several places in Ireland and Scotland, but is extremely rare in England.

Some doubt has been cast on the identity of the British species (first named *Orth. calvescens* by Wilson) with Mitten's species from Madeira; but the doubt is quite unfounded (Venturi's note as to this, cited by Geheeb, Bryol. Atlantica, p. 57, is quite incorrect and incomprehensible), and Mitten's name has the clear priority. Mitten's name was published in 1864, while the first valid publication of Wilson's name was in the Bry. eur., 1866. The identity of the two has been, moreover, confirmed by the discovery of the species in S. Portugal (*Nicholson and Dixon*, 1911).

6. Ulota phyllantha Brid. (*Weissia phyllantha* Lindb., Braithw. Br. M. Fl. *Ulota scotica* Stirt. in Ann. Scot. Nat. Hist. xiv, 106) (Tab. XXXII. H.).

Densely cushioned, ½–1½ inches high. more robust than the previously described species, green or yellow above, rich reddish brown or blackish below. Leaves *very closely curled when dry*, more resembling those of *U. vittata* than any other species, but broader, and without the marginal furrows at base, somewhat obtusely pointed, and *apiculate with the excurrent brownish nerve* which bears at the apex *a dense cluster of reddish brown clavate jointed gemmae;* margin recurved at base; areolation almost as in *U. vittata.* Perichaetial bracts much longer than the leaves; capsule *oblong*, not contracted at or below the mouth. Calyptra slightly hairy. Peristome double; outer of 16 teeth arranged in pairs, reflexed when dry; processes 8, short, fugacious.

Var. *β. stricta* Nicholson, Journ. of Bot. 1900, p. 134. Leaves straight, erect when dry, *scarcely altered in direction and only slightly crisped*, nerve *ceasing below the apex, without gemmae.*

HAB. Trees, and rocks near the sea. Not uncommon. The var. *β*, I. of Stroma, Orkneys (*Dr. P. B. Mason*). Fruit exceedingly rare, spring or summer.

This very interesting plant has only quite recently been found in fruit, first by Howell, in Oregon, and since then in a few herbarium specimens, including a single capsule from Tunbridge Wells and a few from Killarney; and it has been detected in several N. American localities. C. Mueller and Kindberg make two species of what has usually been considered *U. phyllantha*, viz., *U. phyllantha* proper, taller, yellowish brown below, with longer seta and capsule, growing on trees; and *U. maritima* C. M. & K., shorter, green, blackish below, with shorter seta and shorter, thicker capsule, growing on rocks near the sea. They also point out other characters in the leaves, all of which, however, I have found either erroneous or belonging indiscriminately to both forms. Nor will the above distinctions drawn from the vegetative characters hold good, for the short dark plant has been gathered on trees, while the finest specimens of the yellow and brown form I have seen, I gathered on rocks at the Giant's Causeway. The fruiting characters *may* be more important, but it is doubtful whether the capsules can be satisfactorily compared, since those of "*U. maritima*" were young and full of spores, while those of "*U. phyllantha*" were old and empty, a condition which implies a lengthening and narrowing of the fruit. Mrs. Britton concludes that "if we maintain *crispa* and *crispula* as distinct species, then these are," but I am convinced that *no* distinction can be drawn from the vegetative characters of the two forms; nor do I think that the slight difference in the fruiting characters, even as described, is any greater than can often be found between the different gradations even of the single form *U. crispa* var. *intermedia*. I do not think, therefore, there is any ground for separating the maritime form from the arboreal one.

The abundant brown gemmae at the tips of the upper leaves are alone sufficient to distinguish *U. phyllantha* from any other moss. It is almost a cosmopolitan species, and curiously enough grows luxuriantly at the highest limit of vegetation on Chimborazo, while it is often found closer, perhaps, to the sea level than any moss but *Grimmia maritima*.

7. Ulota Hutchinsiae Hamm. (*Orthotrichum Hutchinsiae* Sm.; *Weissia americana* Lindb., Braithw. Br. M. Fl.) (Tab. XXXII. I.).

In flat tufts, very short, rigid, easily falling apart, *dark purplish brown or blackish*. Leaves when dry *not curled, erect and appressed, straight or very slightly twisted, short*, wide and rather obtuse at the apex, the base oval or oblong; nerve strong; basal cells linear or vermicular, a few rows at margin short, sub-quadrate, partly hyaline; upper cells small, rounded, very incrassate. Capsule *oblong-pyriform*, when dry hardly contracted at the mouth (until old); peristome double; calyptra hairy. Autoicous.

HAB. Siliceous rocks, not common; on sycamores, Beddgelert. Fr. summer.

Quite distinct from the other species, except *U. Drummondii*, in the straight, rigid, appressed leaves when the plant is dry; luxuriant specimens, however, and occasionally the uppermost leaves in smaller plants show a slight tendency to twisting. *U. Drummondii* differs in the leaf-form and areolation, in the colour and habitat, the larger capsule with contracted mouth, and other points.

U. curvifolia, a continental species, also growing on rocks, differs in the tufts denser and more coherent, the leaves more twisted when dry, and more strongly papillose, the capsule shorter and darker, and other points.

U. Hutchinsiae is the only British species growing habitually on rocks; it is widely distributed in this country, especially, perhaps, in the West. I have seen it in great abundance in some parts of Sutherland and other localities in the West Highlands.

After seeing an original specimen of the var. *rufescens* E. G. Britt., kindly sent me by Mrs. Britton, I am reluctantly compelled to think our arboreal plant cannot be referred to that variety in spite of the resemblance in habitat and certain other characters. The var. *rufescens* is a distinctly better marked plant, with shorter, wider capsule in addition to other points; it may perhaps be, as Mrs. Britton is inclined to think, a separate species. Our plant must be considered an arboreal form only.

How far the differences in structure and habit are directly the result of the different matrix cannot be said, and it is a question of opinion whether the arboreal habitat in a rupestral plant, and *vice-versa*, should be looked upon or not as in itself constituting a separative character. In some genera it would obviously be valueless; in Ulota, however, and also in Orthotrichum, the habitat is a far more important feature. Macoun goes so far as to say he has never seen a species of Ulota which grows on both rocks and trees, and is, indeed, willing to settle the vexed question of the nomenclature of the present species on that principle alone. But although it is extremely rare to find the habitat changed in a species of Ulota, it is far from being so unusual as the above would indicate; in addition to the present case of *U. Hutchinsiae*, I have found *U. Bruchii* and *U. crispa* growing on rocks, while *U. phyllantha* is indiscriminate in its choice.

51. ORTHOTRICHUM Hedw.

Mosses growing on trees or rocks, comparatively short-stemmed, in close rounded cushions or looser tufts. Leaves

appressed and imbricated when dry, rarely twisted or curled, very hygroscopic, *not distinctly dilated at base*, upper areolation hexagonal or rounded, small; basal *rectangular, usually thin-walled, not strongly incrassate nor vermicular*. Capsule *immersed or emergent on a short seta*, rarely exserted on a longer one, elliptic or cylindrical with a tapering neck, smooth, or with 8 or 16 striae. Peristome mostly double, outer of 16 teeth more or less bipartite and arranged in 8 pairs or singly, broadly lanceolate, not trabeculate, more or less covered with fine lines or papillae; inner when present of 8 or 16 narrow processes. Calyptra *campanulate, sparsely hairy or naked*. Vaginula smooth or hairy with jointed threads, *crowned with an ochrea* or minute cup-like sheath enclosing the seta. Stomata often scattered about the capsule.

A very difficult genus to the systematist, owing in part to the lack of vegetative characters to distinguish most of the species, and in part undoubtedly to the great variability of some of the fruiting characters, and the unquestionable tendency to form connecting varieties between some of the allied species. These difficulties have, however, been lessened by Venturi in his splendid monograph of the European species in Husnot's Muscologia Gallica, on which the following arrangement is based, at least as regards the primary divisions.

It is sometimes stated that 24 or 48 hours' soaking in water is necessary to ascertain the exact shape of the capsule. I am inclined to think that the same end is attained by warming in water for a few minutes over a spirit lamp.

Perfectly ripe yet not too advanced capsules should be chosen for the purpose. As, however, the British species are not as a rule dependent on this character for their distinction, I have laid as little stress as possible on the form of the mature, moistened fruit.

Another point of importance is the direction taken by the dry outer peristome. This falls under three main heads; it may be more or less erect or spreading stellately; or it may be *reflexed* closely on the surface of the capsule, so as to touch it practically throughout its length; or it may be *revolute*, curling backwards, so as to form a somewhat arched curve, only touching or closely approaching the wall of the capsule with its tip or upper part.

Too much importance must not be attributed to the form of the apex of the leaves. In *O. obtusifolium*, *O. rivulare* and *O. Sprucei* it is wide and rounded, in almost all the other species it tapers to a wide point, which is variously obtuse or sub-acute, often differing much in different leaves of the same stem. In certain species such as *O. tenellum* it is usually more obtuse, while in most the acute form predominates, but as a rule it does not afford a sufficiently marked or constant character for specific distinction.

A very important and useful character in the diagnosis of the species is to be found in the stomata which are found in all the species, scattered here and there on the capsule, almost always, but not invariably, about the level of the base of the spore-sac. They may be superficial (Tab. XXXII. J. 12), when the two oval or reniform guard-cells are entirely displayed; or immersed (Tab. XXXIII. J, K. 12), when the guard-cells are more or less hidden by overlapping superficial cells. In order to see the stomata to advantage, it is best to separate a ripe capsule at the base of the neck, cut it longitudinally in two, separate the spore-sac and get rid of the spores, and place it with the outer (*i.e.*, the convex) side upwards on the glass, warming it if necessary over the spirit lamp to get rid of air.

DERIV. ὀρθο-(ortho) upright, and τριχο-(tricho)hair; from the erect hairs on the calyptra.

The British species fall naturally into the following sections.

A. RUPESTRIA. Leaves with recurved margins; not hair-pointed. Peristome teeth erect or spreading when dry. Stomata superficial. *O. rupestre.*

B. CUPULATA. Leaves with recurved margins; not hair-pointed. Peristome teeth erect or spreading when dry. Stomata immersed. *O. anomalum, O. cupulatum.*

C. AFFINIA. Leaves with recurved margins; not hair-pointed. Peristome teeth reflexed or revolute when dry. Stomata superficial. *O. Shawii, O. leiocarpum, O. Lyellii, O. speciosum, O. affine.*

D. TENELLA. Leaves with recurved margins; not hair-pointed. Peristome teeth reflexed or revolute when dry. Stomata immersed. *O. rivulare, O. Sprucei, O. Schimperi, O. stramineum, O. tenellum, O. pallens, O. pulchellum.*

E. DIAPHANA. Leaves with recurved margins; with a hyaline hair-point. Peristome teeth reflexed when dry. Stomata immersed. *O. diaphanum.*

F. OBTUSIFOLIA. Leaves with erect or incurved margins; not hair-pointed. Stomata superficial. *O. obtusifolium.*

1 { Ls. concave, with erect margins, usually rounded at apex *17. obtusifolium*
  { Margin recurved, at least in lower half of leaf....2

2 { Aquatic; ls. oblong or lingulate, with wide apex....3
  { Ls. tapering above towards the obtuse or acute apex....4

3 { Ls. oblong-lingulate, usually obtuse, cells about 10 μ....*9. rivulare*
  { Ls. obovate, upper ones apiculate, cells about 20 μ....*10. Sprucei*

4 { Ls. long, with brown clavate gemmae on surface, very papillose...*6. Lyellii*
  { Ls. without appendages....5

5 { Ls. tapering to serrulate hyaline points....*16. diaphanum*
  { Ls. without hyaline points....6

6 { Capsule smooth, without bands or striae.....*5. leiocarpum*
  { Capsule striated, at least near the mouth.....7

7 { Stomata on capsule superficial..... 8
  { Stomata immersed below the cuticular cells.....11

8 { Peristome teeth erect or spreading when dry ; usually growing on rocks and walls.....*1. rupestre*
  { Peristome teeth reflexed or revolute when dry ; usually on trees.....9

9 { Peristome single ; capsule faintly striate below mouth only...*4. Shawii*
  { Peristome double ; capsule distinctly striate.....10

10 { Capsule striate in upper half, on a longish seta.....*7. speciosum*
   { Capsule long-necked, strongly striate in whole length, on a very short seta *8. affine*

11 { Peristome teeth erect when dry.....12
   { Peristome teeth reflexed or revolute when dry.....13

12 { Capsule tapering below, usually exserted ; seta nearly 1 line *2. anomalum*
   { Capsule abruptly narrowed below, rarely exserted : seta very short *3. cupulatum*

13 { Capsule exserted.....*15. pulchellum*
   { Capsule immersed or emergent only.....14

14 { Vaginula very hairy.....*12. stramineum*
   { Vaginula naked.....15

15 { Capsule short, sharply contracted to the seta.....*11. Schimperi*
   { Capsule elongate, gradually tapering to the seta.....16

16 { Capsule sub-cylindric ; calyptra conic, with few hairs.....*14. tenellum*
   { Capsule oval-oblong ; calyptra campanulate, naked.....*13. pallens*

A. RUPESTRIA.

1. Orthotrichum rupestre Schleich. (Tab. XXXII. J.).

In rather large loose tufts, *dark olive brown*, rarely more yellow or green, soft, but rigid when dry, taller than *O. cupulatum* and *O. anomalum*, 1–2 inches high, the stems sometimes a little spreading and decumbent. Leaves broadly lanceolate, tapering, or suddenly acuminate, but not acute, spreading, and a little recurved or less commonly straight and erecto-patent, when dry straight and imbricated, often very closely and regularly ; cells *small*, rounded-hexagonal or more incrassate and rounded, *in one or two layers*, opaque, more or less strongly papillose ; papillae simple or bifid. Capsule *immersed or emergent*, *oval or* oval-oblong, brownish yellow, *with 8 rather faint short ribs*, very rarely with 8 obscure intermediate ones ; *at base tapering gradually into the very short seta ;* when dry and empty the capsule becomes narrower, darker, *reddish brown*, more strongly striate or sulcate (sometimes, however, nearly smooth), about the same width throughout or sometimes slightly contracted below the mouth.

Stomata *superficial*, mostly occurring at about the middle of the capsule. Calyptra yellowish, with *numerous* long hairs. Peristome teeth in 8 pairs, finally splitting into 16 bifid teeth, yellowish white, *erect or spreading when dry*, usually faintly papillose; processes 8, variously developed, or wanting. Autoicous.

Var. *β. Sturmii* Juratz. (*Orth. Sturmii* Hornsch., plur. auct.). *Capsule more suddenly contracted into the seta.* In addition to this, the most important character, the following points are more characteristic of the variety than of the type;—leaves straighter, more erect, upper leaf cells more frequently in two layers, or even three or four, colour darker green or blackish; texture more rigid; peristome teeth almost smooth, processes wanting.

Var. *γ. Franzonianum* Vent. (*Orth. Franzonianum* De Not.; *Orth. Shawii* De Not., Epil., *non Wils.*). In *small green tufts on trees;* areolation rather laxer and less incrassate; capsule *small*, the striae *rather more distinctly marked.*

Hab. Rocks and walls in mountainous districts, not uncommon; the var. *β* rare; the var. *γ* on trees, Westmorland; Perthshire; Kirkcudbright. Fr. late summer and autumn.

O. rupestre is a very difficult species to describe. It presents few characters of distinction at once marked and stable; indeed, it really represents a group of forms differing little from one another, yet sufficiently to render it very difficult in a diagnosis to comprehend all except by the employment of very indefinite terms. It is perfectly distinct from *O. cupulatum* and *O. anomalum* in the superficial stomata, while in habit often very similar; it rarely however, if ever, has the 16 distinct ribs of the former, while *O. anomalum* and its var. *saxatile* have the capsule more exserted, the former, too, usually showing 16, and the latter more marked ribs. From all the other British species it is easily distinguished either by its rupestral habit or the non-reflexed peristome.

The var. *Sturmii* is a very unsatisfactory plant. The slightness of its claims to independence is best shown by the way in which characters once held distinctive have been dropped and new ones again and again brought forward, only to meet the same fate. All the secondary characters given above have at one time or another been claimed as specific characters, and have one by one been rejected, and all that can be said is that they are more frequently found in plants with the short-necked capsule of var. *Sturmii* than in those of typical *rupestre*. Intermediate forms of capsule are also far from rare.

The var. *Franzonianum* too, is perhaps only an arboreal form of this species; it has, however, a different habit, and the difference of habitat is certainly a striking one in so decidedly a rupestral plant as the present. The Scotch plants have a paler, rather inflated calyptra, and in these as well as in American plants I possess of this variety, the stomata occur on the upper part of the capsule, sometimes indeed very near the mouth. It must not be assumed that arboreal specimens necessarily belong to this variety.

Two other varieties are described as British—var. *rupincola* Huebn., a short, compact form, and var. *Sehlmeyeri Huebn.*, a taller, looser plant, but neither appears of great importance.

O. rupestre prefers dry rocks, and is found most abundantly on stone walls by roadsides in mountainous regions.

B. CUPULATA.

2. Orthotrichum anomalum Hedw. (Tab. XXXII. K.).

In close cushions, rather rigid and fragile, *dark olive green or brown*, ½–1 inch high. Leaves erecto-patent, when dry straight and closely imbricated, widely ovate-lanceolate, somewhat tapering but suddenly and rather broadly pointed; margin recurved, sometimes widely so; nerve strong, ceasing below the point; basal cells rectangular, pellucid, upper hexagonal-rounded, rather thin-walled or incrassate, usually arranged in very regular longitudinal rows; *always in a single layer;* papillae small, simple. Capsule usually *very slightly exserted* above the perichaetial bracts, rather large, pale reddish brown *with 16 brighter coloured ribs*, 8 principal ones extending the length of the capsule, and 8 intermediate less strong and shorter ones; the 8 primary ribs composed of 2-3 longitudinal rows of cells with thick longitudinal and thin cross walls, the 8 secondary ones narrower, sometimes very inconspicuous. Capsule *widely cylindric or oval-cylindric, almost exactly cylindric or sub-urceolate when dry and empty*, tapering quickly into the conical neck *which gradually passes into the rather long seta*. Stomata *immersed, guard-cells* about half covered by the superficial cells. Calyptra yellowish, rarely dark brown, moderately hairy. Peristome teeth 16, or in 8 pairs, erect when dry, marked with faint sinuose lines, *with two small lamellae standing before each tooth*, and reaching about as high as the 2nd or 3rd articulation; processes absent or rudimentary. Autoicous.

Var. *β. saxatile* Milde (var. *cylindricum* Schp., Braithw. Br. M. Fl.; Schp. Syn.). Capsule *narrower, narrowly cylindrical, 8-striate, usually on a longer seta;* peristome teeth in 8 pairs, hardly divided, processes usually more or less well developed. Leaves narrower, rather more acute.

HAB. Rocks; the type usually on siliceous, the var. *β* almost always on calcareous ones. The type rare; the var. frequent. Fr. early summer.

The plant here described as var. *saxatile* is in its typical form fairly distinct from extreme forms of *O. anomalum*, but none of the characters are constant, and as regards the number of striae on the capsules, it is not infrequent to find some with 8 and others with 16 striae on the same plant. Venturi (Rev. Bry. 1896, p. 23) has ably pointed out the instability of this plant, even considered as a variety merely. The peristome characters are quite unreliable. It appears to be common throughout the calcareous districts of Mid-England, where *O. anomalum* proper is quite absent.

O. anomalum differs from *O. cupulatum* in the longer seta and in the form of the capsule, which in that is shorter and wider, more suddenly tapering, and hardly exserted above the perichaetial bracts; in the var. *saxatile* of the present species the seta is sometimes longer than the capsule and neck together. From *O. rupestre* our plant differs notably in the immersed stomata and the often 16-striate, more exserted capsule.

3. Orthotrichum cupulatum Hoffm. (Tab. XXXIII. A.).

Resembling the last, and indeed hardly separable except by the fruit; tufts more often rather loose, leaves oblong-lanceolate or oval-lanceolate, obtuse or sub-acute, margins revolute; cells as in the last, *in one layer*. Capsule *emergent*, rarely almost exserted, *widely oval, quickly narrowed at base to a very short seta;* when dry *widely and shortly cylindrical*, brownish green; when old and empty *urceolate*, contracted below the reddish brown wide mouth, wider and pale below; *ribs usually 16*, eight long and of 2 3 cells in width, reaching nearly to base of the capsule, 8 intermediate, shorter and fainter, rarely almost or quite obsolete. Stomata *immersed*, very little hidden. Calyptra widely campanulate, *very sparsely hairy*, brown or yellowish. Peristome simple, rarely with rudimentary processes; outer teeth *spreading*, resembling those of the last species, *but almost equidistant*. Autoicous.

Var. *β. nudum* Braithw. (*O. cupulatum* var. *riparium* Schp., Syn.). Tufts *wider, looser, dark green*. Capsule on a longer seta, *almost exserted*, with a longer, more tapering neck; calyptra pale, *usually without hairs*. Peristome teeth *more distinctly marked with sinuose lines*, lamellae at base more developed, sometimes reaching nearly to the middle of the teeth.

Hab. Stones and walls, most frequently on those which are calcareous; not uncommon. Var. *β* in similar situations, often on stones by streams, more rare. Fr. summer.

O. cupulatum differs from *O. anomalum* in the shorter, wider, almost barrel-shaped capsule, much less exserted, and more urceolate when empty, as well as in other points. *O. rupestre*, besides the distinguishing characters of its section, has in the dry state a darker, longer, narrower capsule, usually with 8 ribs, and the peristome usually more erect. *O. rivulare* differs in the leaves, broader and more rounded at the summit, the reflexed peristome, etc. The var. *nudum* is considered a separate species by Venturi, but I can hardly see greater differences between it and the type than between *O. anomalum* and its var. *saxatile*. I am inclined to think, however, that strictly speaking the var. *nudum* should form the type of the species, and the more common form, with less highly developed peristome, the variety.

The ribs are not unfrequently obscure, even the primary ones, and rarely reach quite to the base of the capsule, which is almost always wide, pale, and with a rather inflated appearance at maturity.

C. AFFINIA.

4. Orthotrichum Shawii Wils. (Tab. XXXIII. B.).

In small tufts, deep green, somewhat resembling a small form of *O. leiocarpum*, but *shorter, with shorter leaves*, and rather smaller areolation. Capsule *immersed; smooth or with very*

indistinct traces of 8 bands, close to the mouth, oval or oval-oblong, quickly narrowing at the base into the seta. Peristome *single*, of 16 teeth, revolute when dry and touching the wall of the capsule *with their tips*. Autoicous.

HAB. Ash trees, Kilkerran Castle, Ayrshire (*Shaw*).

A very rare species, hardly known elsewhere in Europe except in a few localities in France, Germany and Corsica. It differs from *O. leiocarpum* mainly in the capsule showing some traces of bands, while from *O. rupestre* var. *Franzonianum* it differs in the revolute peristome; the stomata, too, as far as I have been able to examine them, are found in the *lower* half of the capsule, and the latter is almost smooth. It has been suggested, with some plausibility, that it is a hybrid between *O. leiocarpum* and *O. rupestre*.

5. Orthotrichum leiocarpum B. & S. (*O. striatum* Hedw., Braithw. Br. M. Fl.) (Tab. XXXIII. C.).

Tufts usually rather loose and irregular, sometimes more dense, dull green. Leaves *long*, lanceolate, *tapering to a somewhat acute apex*, margins revolute; cells distinct, quadrate-rounded or elliptical, incrassate, papillose. Capsule *immersed, quite smooth, without striae, pale brown, when old whitish*, oval or oblong, very slightly constricted just below the peristome when dry, *abruptly contracted at the base into a very short seta*. Stomata *superficial*, near the base of the spore-sac. Peristome *double*, outer of 16 opaque, highly papillose teeth, with a strong median line and transverse delicate striae, when dry revolute and touching the wall of the capsule *with their tips;* inner of *16 erect, pale-yellowish, broad processes*, often as wide as the teeth, strongly papillose. Calyptra pale, with many yellow hairs. Autoicous.

HAB. Trees, frequent. Fr. early summer.

This is one of the most distinct species, owing to the capsules being quite smooth. They are more immersed than in any of the previous species, except *O. Shawii*.

6. Orthotrichum Lyellii Hook. & Tayl. (Tab. XXXIII. D.).

Tall, robust, dark green or yellowish, in loose soft tufts, 1–2 inches high. Leaves spreading and recurved, when dry appressed and almost straight, or loosely incumbent and somewhat flexuose, *elongate-linear from an oblong base narrower than in most of the species, long*, flexuose, acute; margin slightly recurved above the base of the leaf on one or both sides for a variable distance, but not to apex, faintly erose or denticulate at point, below sinuose or irregular, with prominent distant papillae, especially near the base. Cells at base narrow, rectangular, the upper distinct, oval or rounded-hexagonal, *strongly papillose*, the papillae larger, not crowded, *simple, conical or even linear;*

the nerve and lamina usually produce *long, brown, jointed gemmae*, clavate, often branched. Capsule immersed or slightly emergent, *rather large*, oval-oblong, with a tapering neck as long as itself; yellowish brown, dark brown when old, not or hardly contracted below the mouth, but often slightly narrowed in the middle, between the base of the spore-sac and the neck; with 8 rather indistinct ribs, when old deeply sulcate. Calyptra *large, inflated, pale*, sparingly furnished with long hairs. Peristome double, the outer of 16 teeth resembling those of *O. leiocarpum* and revolute in the same way, inner of 16 processes, similar to those of that species, but *reddish*. Stomata *superficial*, about the base of the spore-sac. Spores *large*, 35–40 *μ*. *Dioicous*.

Hab. Trunks of trees, common. Fruit rather rare, summer.

The most robust of our species, and known at once by the long, flexuose, narrow leaves, covered with reddish brown gemmae, often to such an extent that the older leaves appear rough even to the naked eye. Braithwaite mentions a marked form collected by Spruce near York, with rigid closely appressed leaves; this may be the sub-species *strictum* Vent. Curiously enough, the American plants of *O. Lyellii* are almost without the brown gemmae so characteristic of our British plant.

The brown gemmae (*Conferva Orthotrichi* of old authors) are not confined to *O. Lyellii*, being found on other species such as *O. affine* and *O. speciosum*, but they are much more abundant on our present plant, only occurring on the others sporadically.

7. Orthotrichum speciosum Nees (Tab. XXXIII. E.).

Taller than O. affine, yellowish green or tinged with red; leaves spreading, imbricated when dry, oblong-lanceolate, *tapering, acute*, margin recurved to apex; basal cells narrowly rectangular, upper distinct, very incrassate, rounded or irregularly elliptical, papillose. Capsule *emergent or fully exserted, on a long seta;* oblong-cylindrical or oval-oblong, *hardly narrowed below the mouth*, tapering into a long neck, which is less conspicuous when dry; striae 8, *very faint and almost obsolete* before the spores are shed, more distinct afterwards, while old capsules are often distinctly sulcate. Peristome double, outer of 16 bifid teeth in 8 pairs, opaque, papillose, reflexed when dry so that a considerable part of the upper half of the tooth is appressed to the wall of the capsule; processes 8, white, *large*, papillose, incurved. Autoicous.

Hab. Trees in mountainous districts, rarely on rocks; very rare. Fr. late summer.

Readily known from *O. affine*, and indeed from most of the allied species, by the long seta and exserted capsule, which is almost smooth until old and empty. *O. leiocarpum* differs in the immersed capsules, *O. Shawii* in the differently revolute peristome, the absence of inner processes, and the more immersed fruit. Though common on the continent, it is one of our rarest species, although frequent within a limited area in Aberdeenshire and Inverness.

8. Orthotrichum affine Schrad. (Tab. XXXIII. F.).

In small loose tufts, dull green ; leaves spreading, when dry straight and more or less imbricated, *broadly oblong-lanceolate, sub-acute,* margin widely revolute ; areolation rounded-oval or hexagonal-rounded, incrassate, *papillose.* Capsule *emergent or very slightly exserted, oblong-cylindrical with a rather long tapering neck,* ribs 8, each of 3–4 rows of cells ; *greenish,* when old brown, sulcate, and very slightly contracted below the mouth. Stomata *superficial,* rather below the middle of the capsule ; calyptra *narrow, greenish,* darker above, *slightly hairy ;* vaginula *glabrous ;* peristome double, outer of 16 teeth in 8 pairs, reflexed when dry so as to touch the capsule almost with their whole length, papillose, processes 8, filiform. Autoicous. Spores 20–25 μ.

Var. β. *rivale* Wils. Dark green or blackish. Leaves *of a succulent texture, broad, obtuse, or shortly apiculate,* not imbricated when dry. Calyptra narrow ; capsule *more exserted, broader, and less tapering below, less contracted when dry,* ribs *broader,* of 4–5 rows of cells.

Var. γ. *fastigiatum* Huebn. (*O. fastigiatum* Bruch, plur. auct. ; *O. neglectum* Schp., Syn.). *Shorter and more compact* in all its parts, dark green ; leaves shorter ; capsule more immersed, *shorter, more contracted and urceolate when dry,* the ribs broader ; peristome teeth usually minutely striate, processes wider.

HAB. Trees, sometimes on stones, very common. The var. β on trees by streams, not common ; the var. γ rare. Fr. summer.

This is our commonest species, and very variable. The capsule especially varies in the amount of its exsertion and in form. The var. *fastigiatum* is another of those forms which have been described as separate species on constantly changing and inadequate grounds ; it appears to be incorrect to attribute to it large, thin-walled areolation as has been done in most English works, which I followed in Ed. I. ; Limpricht describes it with smaller cells than *O. affine,* and this is the case in specimens from Bruch's own herbarium. Limpricht describes a variety of *O. fastigiatum* with the fruiting characters of that plant, but with the tall habit of *O. speciosum,* showing how unstable *O. fastigiatum* is as a species.

D. TENELLA.

9. Orthotrichum rivulare Turn. (Tab. XXXIII. H.).

In dark green or blackish loose tufts, often floating and elongated, *1–2 inches long.* Leaves spreading, when dry loosely incumbent, *broadly oblong-lingulate,* somewhat variable in form above, broad and rounded or somewhat abruptly narrowed, but *always obtuse in general outline,* with or without a short blunt

apiculus ; sometimes cucullate ; *entire or irregularly denticulate or eroded at apex ;* margin recurved throughout ; *nerve prominent at back*, ceasing some way below the summit ; cells *small, 10–12 μ in diameter*, rounded or rounded-quadrate, incrassate, *faintly papillose ;* at base quadrate-rectangular, not much enlarged. Capsule immersed or more or less exserted, large, oval or oval-oblong, *abruptly contracted into the seta, when dry and empty strongly contracted below the mouth*, dark brown ; ribs 8, *strong, wide, shining ;* calyptra *inflated, smooth*, dull green, *without hairs ;* peristome double, outer teeth united in 8 pairs, when dry reflexed against the wall of the capsule, finely papillose ; *processes 16*, incurved, long ; the alternate ones often ill-developed. Vaginula slightly hairy. Stomata *immersed, almost hidden by the overlapping cells*. Spores small, about 12 μ. Autoicous.

Hab. On rocks and tree roots by water, in places at least partially submerged, not common. Fr. summer.

A distinct species, both in its habitat, and its dark colour, as well as in the obtuse leaves and large strongly ribbed capsule, markedly contracted below the mouth when dry. From *O. affine* var. *rivale* the obtuse leaves, larger capsule, and especially the immersed stomata, distinguish it ; the naked smooth calyptra is also characteristic. *O. Sprucei* is really the only species which might be confused with it, but the more broadly rounded summit of the leaves, usually showing characteristic apiculus, and the much larger cells are in that species quite distinctive.

10. Orthotrichum Sprucei Mont. (Tab. XXXIII. G.).

Resembling *O. rivulare* but *shorter* and denser, *softer*, dull green. Leaves *more flaccid*, somewhat variable in form, but *always broader in the upper part than in that species*, usually oval-oblong or widely elliptical, *at apex broad, rounded, quite obtuse or with a minute acute apiculus formed of about one row of cells ;* margin recurved to near apex ; entire or nearly so at summit ; nerve thinner and less prominent ; *cells larger*, the basal laxer and more pellucid, *the upper very large, about 20 μ in diameter*, very distinct. Capsule immersed, a little longer, rather less contracted below the mouth when dry, ribs a little less strong ; processes more often only 8 ; other characters as in *O. rivulare*.

Hab. On wood and trees by water ; frequent by mountain streams in the North of England, elsewhere rare. Fr. summer.

This very interesting species has only been found out of Britain in a few localities in France and Belgium, and in one spot in N. America. In areolation and leaf form it is quite distinct from the last, and the habit and fruiting characters present minor but still not unimportant differences. The minute apiculus at the apex of the leaves is very curious and distinct ; it is however frequently wanting, especially in the older leaves. The stomata in this and the last species are so nearly covered by the overlapping cells as to be sometimes difficult to detect, and are, as is the case often with the immersed forms, more easily found by the radiating cells of the surface layer than by the form of the guard-cells.

11. Orthotrichum Schimperi Hamm. (*O. fallax* Schp., Syn.) (Tab. XXXIII. I.).

Very small, in short, close tufts, not ½-inch high, usually much less, dark green. Leaves erecto-patent, imbricated and straight when dry, *small, oblong-lanceolate, rather broad, obtuse or shortly acuminate ;* margin recurved ; cells rounded-hexagonal, *distinct, not much incrassate*, minutely papillose. Capsule *very small, immersed*, oval-oblong with a short neck, when dry narrow and slightly contracted below the mouth, ribs 8, rather strong, orange. Stomata about the middle of the capsule, *immersed, mostly about half closed with the overlapping cells ;* peristome double, outer of 8 pairs of reflexed teeth ; processes 8. Calyptra *short, inflated, smooth and shining ;* naked or with very few hairs, *pale*. Spores small, 12–15 μ. Autoicous.

HAB. Trees ; rare. Fr. spring.

This is perhaps the smallest of our species, and easily known by the dwarf compact habit, the rather obtuse leaves, and the pale yellow, smooth, inflated calyptra. The distinction between this species and *O. pumilum* Swartz (*non* Dicks.) is very slight and I cannot help thinking unimportant ; Venturi bases it mainly on the form of the base of the capsule, or rather its neck, but his figures show hardly any difference between the two plants, and according to Philibert this character is quite valueless ; the latter author makes the degree of closing of the stomata and the time of fruiting the specific distinction, *O. Schimperi* having the stomata more open and the fruit ripened a month earlier, but the difference, even as described by him, is very small. Specimens which I gathered in Northamptonshire in 1885, while showing the stomata of *O. Schimperi* have the capsules more like those of *O. pumilum* Sw.

12. Orthotrichum stramineum Hornsch. (*O. praenubilum* Stirt. in Ann. Scot. Nat. Hist. xix. 242.). (Tab. XXXIII. J.).

In yellowish green, or bright green tufts, resembling *O. affine*. Leaves resembling those of that species. Capsule more or less emergent, *rather short, yellowish brown, oblong-elliptic, quickly contracted into a short neck, about half the length of the capsule*, with 8 broad, *prominent* ribs, of 4–6 rows of strongly incrassate cells ; when ripe and open constricted just below the narrow mouth, then quickly widening again ; peristome teeth in 8 pairs, yellow, reflexed when dry, papillose, processes 8, more rarely 16 ; *stomata immersed, almost closed by the very swollen, elevated overlapping cells ;* calyptra *pale yellow with a darker point*, slightly hairy. Vaginula *very hairy*. Autoicous.

Var. β. *patens* Vent. (*Orth. patens* Bruch, Schp. Syn.). Ribs of capsule *much fainter*, of *two rows* of less incrassate cells.

HAB. Trees, rarely on rocks ; not uncommon in mountainous districts. The var. β rare. Fr. summer.

There is no difficulty in recognising this species, under the microscope, from *O. affine*, the very hairy vaginula and immersed stomata at once distinguishing it; in the field there is more resemblance, but the straw coloured calyptra, and the capsule suddenly constricted below the small mouth, then much widened (somewhat after the fashion of the tied up mouth of a sack), with very distinct ribs, is sufficient to identify it as a rule; old capsules, however, scarcely differ. *O. tenellum* has a narrower, brighter coloured capsule, with a more tapering neck.

13. Orthotrichum pallens Bruch (Tab. XXXIII. K.).

In small, *pale green* cushions, *very short*, not ½-inch high. Leaves lanceolate, somewhat obtuse or variously pointed; margin recurved; basal cells very thin, almost hyaline, upper hexagonal or rounded, *rather large*, somewhat incrassate, papillose. Capsule emergent, oval-oblong, *with a long tapering neck, pale brownish yellow*, when dry *narrow, cylindrical, slightly contracted below the mouth;* ribs 8, as long as the capsule; stomata *immersed, but little covered by the overlapping cells*, which are not swollen; peristome double, outer of 16 teeth closely joined in pairs, pale yellow or orange, reflexed when dry, finely papillose; processes 8, with 8 rudimentary intermediate ones. Spores small. Calyptra *narrow, naked*, pale. Vaginula *glabrous or nearly so*. Autoicous.

HAB. Trees; rare. Fr. summer.

Extremely near to *O. stramineum*; differing principally in the scarcely hairy vaginula and calyptra, and the form of the stomata. Larger than *O. Schimperi*, with larger, longer capsules, and narrower, less inflated calyptra. The capsule is less brightly coloured than in *O. tenellum*, with more open stomata, and is rather shorter and wider, less cylindrical.

14. Orthotrichum tenellum Bruch (*O. prasinellum* Stirt. in Ann. Scot. Nat. Hist. xix, 241.) (Tab. XXXIV. A.).

In *short, dark green* tufts about ½-inch high. Leaves erecto-patent, erect and imbricated when dry, short, *narrow*, lanceolate or oblong-lanceolate, *obtuse or very slightly acuminate*, margin recurved nearly to apex; cells hexagonal or rounded, incrassate, *faintly papillose*. Capsule *distinctly emergent or even slightly exserted, bright golden brown, narrowly cylindrical, not contracted below the mouth;* ribs 8, *long, prominent*, of 3–4 rows of cells with the lateral walls strongly incrassate; stomata *immersed, almost closed by the swollen overlapping cells:* peristome double, outer teeth in 8 pairs, reflexed when dry, pale brown, finely papillose, processes 8. Vaginula *glabrous*. Calyptra *narrow*, pale greenish yellow, *smooth, scarcely hairy*. Autoicous.

HAB. Trees; not common. Fr. summer.

Resembling small plants of *O. affine*, but readily known when with ripe fruit by the bright orange brown capsules, narrowly cylindrical, not contracted below the mouth; also by the narrower, more obtuse leaves, with less prominent papillae, and the immersed stomata.

15. Orthotrichum pulchellum Smith (Tab. XXXIV. B.).

Tufts *short*, loose, olive green or yellowish green, soft, less than ½-inch high. Leaves erecto-patent, *when dry flexuose and slightly curled*, from a narrow oblong base *lingulate-lanceolate or linear*, acuminate and acute; margin widely recurved to near apex; nerve thin; areolation rounded or hexagonal-rounded, incrassate, in rather regular longitudinal lines, *hardly papillose*. *Capsule quite exserted, on a seta 1–1¼ lines long, small*, pale brown, oval-oblong, contracted into a short neck; when dry cylindrical, not or little constricted below the mouth, ribs 8, rather narrow, stomata *immersed*, variously covered by the overlapping cells; peristome double, *orange-red*, outer of 8 pairs, reflexed when dry, finely papillose, processes 8 or 16, filiform. Calyptra naked, yellowish below, brown at the point. Spores rather large, about 25 μ. Autoicous.

HAB. Trees, sometimes on walls; not common. Fr. early summer.

One of the prettiest species of the genus, abundantly distinguished by the leaves twisted when dry, the small exserted capsule and orange-red peristome. It has in some respects rather the aspect of a Ulota such as *U. crispa* var. *crispula* than of an Orthotrichum; but the coloured peristome alone would at once distinguish it.

According to Limpricht, the British plants referred to var. *Winteri* by Braithwaite (*O. Winteri* Schp.), do not belong to that variety or species, but to *O. pulchellum* type, and certainly the Bedfordshire specimen that I have seen does not differ appreciably from the type form; the var. *Winteri* must therefore be expunged from our list.

E. DIAPHANA.

16. Orthotrichum diaphanum Schrad. (Tab. XXXIV. C.).

In small dense cushions, about ½-inch in height, greyish green. Leaves erect when dry, *elliptical-oblong or oblong-lanceolate, acuminate; with a rather long, hyaline, denticulate hair-point* which is wide at the base; margin recurved to near apex, nerve faint, narrow; basal cells lax, rectangular, *the upper large, 15–20 μ*, irregularly rounded-hexagonal, thin-walled, *minutely papillose*. Seta short, capsule emergent, ovate-oblong, *suddenly contracted into the seta, thin-walled*, pale, with 8 *very faint ribs*, when dry more strongly striate, slightly contracted at the mouth. Stomata *immersed*, numerous, partly closed. Calyptra not or hardly hairy, yellowish green. Peristome double, outer of *16 pale slender teeth, spreading and somewhat recurved when dry, but not reflexed on the wall of the capsule*, processes filiform, papillose. Autoicous.

Hab. Trunks of trees and wooden fences. Common. Fr. spring.

Unique among our native species in the diaphanous points of the leaves. The capsules are sometimes almost smooth without trace of ribs. The slender peristome teeth, spreading in a stellate manner, give the capsules a very pretty appearance. A form is found (var. *aquaticum* Davies) in damp spots, principally in the south of England, having the leaves studded with bright green, septate gemmae.

F. OBTUSIFOLIA.

17. Orthotrichum obtusifolium Schrad. (Tab. XXXIV. D.).

In small dense tufts, dull yellowish green, *stems turgid*, with a very few short thick branches, hardly $\frac{3}{4}$-inch high. Leaves erecto-patent, *when dry closely imbricated, short and very broad, oval-oblong*, very narrow at the insertion, concave, *broad and rounded at summit, margin erect*, not recurved nor involute, with projecting papillae, which at the apex almost amount to denticulations; basal cells rectangular, upper hexagonal or elliptic, large, about 15 μ, incrassate, each with a stout projecting often bifid papilla. Short brown or green clavate *jointed gemmae* are usually found on the surface of the leaf. Capsule *immersed*, oval-oblong with a tapering neck, with 8 faint ribs; stomata superficial; calyptra naked, brownish; peristome double, yellowish. Dioicous.

Hab. Trees, rare and barren.

This very distinct species is readily known by its broad, rounded leaves, which give a tumid appearance to the stems; in its erect leaf-margins, too, it is quite different from the other species of the genus so far as our British plants are concerned. There is, however, a continental and N. American species, *O. gymnostomum* Bruch, which in the leaf-form closely resembles it, but has involute margins, and no peristome. A specimen of this species labelled "England, Yorkshire," is said by Braithwaite to have been sent to Venturi by Jaeger.

Although the leaves in the present plant are normally and, indeed, almost constantly obtuse, yet they may occasionally be found more acute; I have found them obtusely pointed in plants of my own collecting, and Mrs. Britton mentions plants from Jordansville, N.Y., with the leaves acute or apiculate, and the perichaetial bracts acuminate, on stems bearing also the ordinary rounded, obtuse, leaves. It is possible that owing to its small size and the absence of fruit this species may have been overlooked and may be really more common than has been thought; I have found it in several localities in Northamptonshire, principally on ash, but also on willows.

ORDER XII. SCHISTOSTEGACEAE.

Plants small, slender. Stems of two forms, barren, with the leaves *distichous, having their bases confluent;* and fertile, with similar but smaller leaves or with only a terminal tuft or rosette of small leaves. Areolation *lax;* nerve *none.* Capsule *minute, sub-globose, gymnostomous;* lid plano-convex; calyptra small, conical.

A very distinct Order, consisting of a single genus, and represented by one species only, having little affinity with any other moss.

52. SCHISTOSTEGA Mohr.

Characters those of the Order.

DERIV.—σχιστο-(schisto) split, and στεγος (stegos) a lid; alluding to a supposition that the lid of the capsule finally became split.

1. Schistostega osmundacea Mohr (*Mnium osmundaceum* Dicks.) (Tab. XXXIV. E.).

In glaucous green patches, finally reddish brown. Stems *very slender and delicate*, about ¼-in high, springing from a *persistent, highly refractive protonema.* Barren stems naked at base, with *two rows of vertically placed leaves* above; leaves shortly oblong, pointed, *nerveless, confluent at base; cells large, rhomboidal*, chlorophyllose. Fertile stems resembling the barren, or naked except for a small tuft of terminal leaves, from which springs the slender seta; capsule *minute, sub-globose, erect; gymnostomous.* Dioicous.

HAB. Clefts and caves in sandstone rocks; not common. Fr. spring.

A very beautiful and distinct moss, which it is impossible to mistake for any other, on account of the distichous, confluent leaves, giving a frond-like appearance to the stem, like a miniature fern such as the Hard Fern (*Lomaria Spicant*). The most striking character of this moss is the highly refractive structure of the protonema, which gives a beautiful golden green lustre to the plant and seems to fill with light the crevices and caves where it dwells.

ORDER XIII. SPLACHNACEAE.

Usually rather short-stemmed mosses, with erect symmetrical capsules mostly on long setae, with a distinct apophysis; peristome none, or single, with the teeth usually in pairs. Leaves broad, flaccid, with lax, more or less hexagonal, smooth areolation

Calyptra entire and conical, or cucullate. Almost always growing on the excrement of animals or decaying animal matter.

The lax areolation, erect symmetrical capsule and well-marked apophysis are the distinctive features of this Order, and taken together readily enable the student to recognise species belonging to it from the Funariaceae, and from Meesia and Amblyodon; the areolation alone will distinguish them from most other mosses.

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53. **OEDIPODIUM** Schwaeg.

Short-stemmed, *succulent-leaved* plants. Leaves *obtuse, rounded*, broadly nerved. Capsule *sub-globose*, with a *very long narrow tapering apophysis resembling a seta*; peristome *none*.

A genus containing only a single species, which is very often, and with some reason, placed in a separate Order. The grounds for so doing, however, appear to me to be outweighed by its undoubted affinity with Splachnaceae.

DERIV.—*οἰδι-*(oedi) swollen, and *πους* (pous) foot, from the swollen footstalk or apophysis.

1. **Oedipodium Griffithianum** Schwaeg. (*Bryum Griffithianum* Dicks.) (Tab. XXXIV. F.).

Plants gregarious or somewhat tufted, dark green, ¼ to 1-inch high. Leaves succulent, flaccid and crisped when dry, the uppermost *in a spreading rosette, concave, obovate-spathulate from a very narrow base, very obtuse*, usually bearing rather large, axillary, bright green *gemmae*; margin plane, somewhat undulate, *entire*, at base *fringed with pale jointed hairs or cilia*: nerve *broad*, vanishing at some distance below the apex; cells *large, hexagonal or rounded*, gradually smaller towards apex; the marginal row sub-quadrate or rectangular, the basal very thin, pale, rectangular. Capsule brown, from globose to shortly elliptical, small, on a pedicel 3–6 lines long, the greater part of which, or perhaps the whole, must be regarded as a *narrow apophysis, gradually tapering downwards* into the vaginula, hollow for a great part of its length, *succulent, pale* (brown after maturity), twisted and rugose when dry. Calyptra small, conical; lid convex, mamillate. Columella not exserted, dilated at top.

HAB. On earth in crevices of high mountain rocks, rare. Fr. late summer.

Easily known, even when barren, by the rosettes of rounded, translucent leaves, often bearing gemmae, this very curious and interesting moss is still more distinct in fruit, the pale soft pedicel and rounded fruit having much

more the appearance of the analogous structures among the Hepatics than of the ordinary moss fruit. The ciliate leaf-base is also remarkable. The leaves become very dull green when dry, and the moss is then comparatively inconspicuous. The upper part of the apophysis bears large stomata. The plant loves dark crevices filled with black peaty soil and does not grow on the actual rock.

It has only been found, outside Great Britain and Ireland, in a few localities in Scandinavia, in Greenland, and Alaska.

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54. SPLACHNUM L.

Plants growing in loose tufts; leaves more or less *obovate or broadly lanceolate*, wider above the base; cells *lax, hexagonal, smooth*. Seta *long*, capsule oval or cylindric, *apophysis wide, pyriform, globose or umbrella-shaped;* peristome teeth 16, in pairs, usually reflexed when dry; of *three layers in thickness*, the median larger with numerous vertical and oblique walls, visible from the inner surface as fine lines connecting the transverse ones. Male flowers *sub-discoid*, terminal.

In this genus, as with most of the Order, the leaves, owing to the large thin-walled cells, become very soft and flaccid when dry; the seta, too, is usually of a rather succulent, soft texture, and easily becomes crushed and bent. The wide apophysis, generally of a different colour from the capsule, is the chief characteristic of the genus; it is, indeed, so conspicuous that the beginner is apt to take the apophysis for the capsule itself. In some continental species, *S. luteum* and others, this organ is extraordinarily dilated, being half-an-inch or more across, and brilliantly coloured, the seta being as much as six inches in length.

DERIV.—*σπλαγχνον*, the viscera (possibly from the rugose appearance of the dry apophysis); a Greek name for some cryptogamic plant.

1 { Ls. roundish, entire, obtuse; apophysis globose, very large ..... *3. vasculosum*
{ Ls. acute, with longish acumen, often toothed 2

2 { Apophysis roundish-ovate, little wider than capsule ..... *2. sphaericum*
{ Apophysis large, pyriform, tapering below ..... *1. ampullaceum*

1. Splachnum ampullaceum L. (Tab. XXXIV. G.).

Stems slender, ½–1 inch high, tufted. Leaves distant, erecto-patent, twisted when dry, varying from *narrowly lanceolate to obovate-lanceolate*, from a narrow base, *with a long tapering acumen, coarsely serrate*, especially above, the nerve vanishing at or below the point. Cells large, irregularly rhomboid-hexagonal, the marginal row rather narrower and slightly discoloured. Seta

red, 1–2 inches long; apophysis large, *widely pyriform, much broader than the capsule, gradually tapering into the seta, usually purplish above, pale lilac below,* rugose when dry; sometimes narrowly pyriform. Capsule shortly cylindrical, when dry narrowed in the middle, yellowish brown; lid convex, obtusely mamillate; peristome of 16 teeth in pairs, pale yellow; strongly reflexed against the mouth of the capsule when dry. Usually autoicous; male flowers terminal, sub-discoid, bracts squarrose.

Hab. On the excrement of cattle in boggy places in sub-alpine districts; not uncommon. Fr. summer.

The specific name correctly describes the form of the fruit, which has, when fully developed, very much the form of a Roman ampulla, of which the neck is formed by the capsule; the apophysis, however, is frequently narrow, and the same tuft will exhibit a variety of forms. I have specimens with the apophysis as much as half-an inch in length. The colouring, too, is highly variegated, and often very pretty.

S. Turnerianum Dicks. is only a form with narrow apophysis.

2. Splachnum sphaericum Linn. fil. (*S. pedunculatum* and var. *sphaericum* Braithw., Br. M. Fl.) (Tab. XXXIV. H.).

Differs from *S. ampullaceum* in the leaves wider, *obovate-spathulate or sub-orbicular, abruptly and very shortly or more longly acuminate,* the margin *entire or sinuose-dentate,* rarely distinctly serrate, one or two rows of cells often narrower and discoloured; nerve reaching nearly to the summit. Seta *very thin and weak,* paler, variable in length, 1 or 2, rarely up to 6 inches. *Apophysis smaller, only slightly wider than the capsule, oval or globose, blackish, quickly contracted into the seta;* narrower and more tapering at base when dry, rugose. Capsule rather shorter and broader; columella much exserted when dry, dilated at apex. Teeth of peristome orange. Dioicous. Male flower on a separate plant, apical cell of paraphyses *narrow, pointed.*

Hab. In similar situations, but usually at rather higher altitudes, common in mountainous districts. Fr. summer.

S. sphaericum is easily known from the last species by the shape and colour of the apophysis, as well as by the broader less serrate leaves; *S. vasculosum* differs in the obtuse leaves, usually shorter seta, large apophysis, etc.; *Tetraplodon mnioides* in the narrower leaves, firmer seta, and more tapering, firmer apophysis, which is usually narrower in proportion to the capsule. The latter plant is quite distinct when the capsules are fresh, but in old and dried specimens of *S. sphaericum* the apophysis becomes narrowed and more tapering, and the distinction diminishes.

Tab. XXXIV. H shows (necessarily somewhat diagrammatically, the papillae and other points being omitted for the sake of clearness) a peristome tooth of *S. sphaericum* viewed from the outer or dorsal surface. The darker horizontal lines show the plates of the dorsal layer, the vertical and oblique lines are those of the median layer, and the faint horizontal ones the divisions of the plates of the ventral surface.

Tetraplodon Wormskjoldii differs in the autoicous inflorescence, the leaves wider at the base and less spathulate, usually entire at apex, the smaller capsule, smaller, irregular peristome teeth, etc.

3. Splachnum vasculosum L. (Tab. XXXIV. I.).

In pale or deep green tufts, often black below, 1–3 inches high. Leaves distant, *widely obovate or sub-orbicular, rounded or shortly and bluntly pointed, but almost always obtuse, entire;* nerve ceasing below apex; marginal cells rectangular, rather narrow, discoloured. Capsule rather small, shortly cylindrical, contracted below the mouth when dry; *apophysis large, globular, dark purplish black,* slightly rugose when dry. Peristome teeth rather short. Columella exserted. Dioicous. Perigonial bracts squarrose, oval, acuminate, obtuse.

HAB. Springs and bogs on high mountains; very rare. Fr. summer.

A fine and distinct species, readily known, even when barren, by the rounded entire obtuse leaves, which are rather glossy when dry and less altered than in the two previous species. It is possible that the barren plant may have been overlooked and may be more frequent than is usually supposed.

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55. TETRAPLODON B. & S.

Mosses resembling Splachnum, usually with *narrower, longly tapering leaves.* Capsule oval-cylindrical, *apophysis of the same colour and texture,* more solid than in Splachnum, *narrower and more tapering,* not much wider than the capsule; teeth of peristome 16, at first arranged in fours, finally in pairs, rarely equidistant; of two layers only, without interior vertical and oblique lines. Columella *not exserted.*

A small genus, chiefly separated from Splachnum by the narrower apophysis, more tapering and not inflated, of the same colour and texture as the capsule, and the structure of the peristome teeth.

DERIV.—τετραπλο-(tetraplo) fourfold, and ὀδους (odous) a tooth; from the arrangement of the peristome teeth.

1 { Ls. toothed above; seta scarcely longer than leaves, pale...*2. angustatus*
  { Ls. entire or almost so; seta longish.....2

2 { Seta very slender, pale; capsule (with apophysis) small...*3. Wormskjoldii*
  { Seta stout, red; capsule (with apophysis) large.....*1. mnioides*

A. EU-TETRAPLODON.

Peristome teeth at first in fours, finally in pairs.

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1. Tetraplodon mnioides B. & S. (*Splachnum mnioides* Sw.; *Tetraplodon bryoides* Lindb., Braithw. Br. M. Fl.) (Tab. XXXV. A.).

Densely tufted, stems 1–3 inches high. Leaves crowded, ovate-lanceolate or narrowly obovate-lanceolate, gradually or suddenly acuminate and *tapering to a long flexuose subula*, appressed and twisted when dry; *concave, entire;* nerve yellowish, *forming the greater part of the subula;* cells rhomboid-hexagonal or sub-rectangular, the marginal often, but not constantly, narrower and yellowish. Seta *stout*, red, variable in length, $\frac{1}{2}$–2 *inches;* capsule shortly cylindrical, when dry contracted below the mouth, at first brown, with a greenish apophysis, *both finally becoming dark purplish black; apophysis pyriform*, slightly narrower above than the capsule, tapering at base, thick-walled; peristome teeth reflexed when dry, large, regular in outline, entire at margin, highly papillose, orange red. Autoicous. Male flower terminal, soon becoming lateral by innovation.

Hab. Decaying animal matter on mountains; not common. Fr. summer.

The seta exhibits considerable variation in length in this species, sometimes hardly elevating the capsule above the leaves, at others being two inches in height. In the latter case it is a very conspicuous moss, especially as the fruit is usually produced in great profusion. It varies much, too, in form of leaf and length of capsule, and the var. *Brewerianus* (*Splach. Brewerianum* Hedw.) appears to be only an unimportant form of this kind. A more marked variety, var. *cavifolius* B. & S. has the leaves very concave and obovate, almost cochleariform, thus linking our plant very closely with a third species, *T. urceolatus* B. & S.

T. angustatus differs markedly in the hardly exserted capsule and serrate leaf.

2. Tetraplodon angustatus B. & S. (*Splachnum angustatum* Sw.) (Tab. XXXV. C.).

Small, densely tufted, $\frac{1}{2}$–2 inches high, pale green, reddish below with dense tomentum. Leaves narrowly ovate-lanceolate, with a tapering flexuose subula as in the last; margin *sharply spinulose-serrate*. Seta pale, *very short, capsule hardly raised above the leaves, pale reddish brown*, smaller than in the last; *apophysis pale*. Autoicous.

Hab. In similar situations to the last, very rare; Scotland; Wales. Fr. summer and autumn.

Very different from the last in the narrower, serrate leaves, the smaller, less exserted capsule of a different colour. As in that species, the apophysis when the capsule is just mature is no wider than the capsule, indeed at times narrower; its subsequent relative widening is due to the contraction of the capsule.

B. HAPLODON.

Peristome teeth at first in pairs, finally equidistant.

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3. Tetraplodon Wormskjoldii Lindb. (*Splachnum Wormskjoldii* Hornem., Schp. Syn.) (Tab. XXXV. B.).

In soft tufts, usually short, rarely becoming tall and robust, 2–6 inches high; stems very slender, repeatedly forked. Leaves *broadly ovate*, rather quickly narrowed to a rather short acumen; nerve very slender, ceasing below the apex, margin *entire or nearly so*. Cells resembling those of *S. sphaericum*, the marginal row *much larger*, inflated. Seta *very slender, pale;* capsule *very small*, shortly elliptic, about the same width as the short, ovate, slightly tapering apophysis; after the fall of the lid the capsule becomes sub-globose, the apophysis narrower, finally the capsule becomes *extremely wide-mouthed and short, turbinate*, much wider than the apophysis. Peristome teeth finally equidistant, *small, irregular in outline, thin*, yellow. Autoicous; male flowers on very slender axillary branchlets, apical cell of paraphyses *wide, obtuse*.

HAB. In wet peaty places, very rare. Widdy Bank Fell, Teesdale, Durham, 1901 (*Horrell and Jones*). Craig Chailleach, Perthshire (*Haggart*).

The position of this plant is doubtful, as in the vegetative characters and others it most resembles Splachnum, while in the structure of the peristome and included columella, it agrees with Tetraplodon. Up to the time of its discovery in Britain, it was looked upon as a typical arctic, or boreal species, ranging through all the high latitudes of North America and Europe, to Siberia. Our plant is the unusual tall robust form with larger leaves. It most resembles *Splach. sphaericum*, and could indeed hardly be mistaken for any other plant; the inflorescence, differently shaped leaves, etc., will separate the two, as pointed out under that plant, even in the absence of fruit.

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56. TAYLORIA Hook.

Usually fine mosses with long setae; *calyptra contracted at base*, conical. Apophysis *more or less pyriform, much narrower than the capsule*, which is wide-mouthed when dry. Areolation *large*, rhomboid-hexagonal.

Tayloria Froelichiana has been recorded as British, but erroneously, and must be erased from our list.

DERIV.—After Dr. Taylor, the author with Sir W. J. Hooker of the Muscologia Britannica.

{Leaves acute, toothed.....*1. tenuis*
{Leaves obtuse, entire.....*2. lingulata*

1. Tayloria tenuis Schp. (*Splachnum tenue* Dicks.; *Tayloria serrata* var. *tenuis* B. & S., nonnull. auct.) (Tab. XXXV. D.).

Loosely tufted, soft, slender. Leaves very thin and tender, *widely spathulate, shortly acuminate, acute;* nerve reaching nearly to apex; margin *serrated above*. Seta very slender; capsule with a long narrow tapering apophysis, small, oval, wide-mouthed when dry and empty; columella *much exserted;* peristome teeth *reflexed when dry, purplish*, long. Autoicous; male flower sub-discoid, terminal on branches.

HAB. Decaying matter on mountains, very rare. Scotch Highlands. Dunheath, Caithness (*Lillie*); Derry, Ireland (*Stewart*). Fr. late summer.

Quite distinct from the next species in the reflexed peristome teeth, the exserted columella, and serrated acuminate leaves. It frequently more nearly resembles *Tetraplodon mnioides*, the capsule and apophysis being about the same width until after maturity, and even capsules gathered ripe do not always dry with the apophysis narrower than the capsule. It may, however, always be known from that species by the serrated leaves with short points and nerve ceasing below the apex.

2. Tayloria lingulata Lindb. (*Splachnum lingulatum* Dicks.; *Dissodon splachnoides* Grev. & Arn., plur. auct.) (Tab. XXXV. E.).

Tall, densely tufted, 1-4 inches high, blackish below, dark green above. Leaves sub-erect, when dry not much crisped nor twisted, glossy; large, *obovate-lingulate, obtuse*, concave; margin *entire or slightly irregular at apex* with the projecting transverse cell-walls; nerve ceasing below apex. Seta bright red, shining, 1–2 inches long. Capsule bright brown, rounded-oval, when dry and empty wide-mouthed and somewhat turbinate; apophysis tapering, much narrower than the ripe capsule; lid convex with an apiculus of varying length. Peristome teeth 16, not in pairs, *yellowish, erect when dry*. Columella *slightly exserted*. Synoicous, or autoicous with the male flower gemmiform.

HAB. Bogs on high mountains in Scotland, rare. Fr. late summer.

A very fine and distinct species, as well in the capsule as in the leaves. Like most species of this Order, it varies much in the size of its parts. The large cells give a very marked appearance to the dry leaves under the lens.

Order XIV. FUNARIACEAE.

Plants usually with wide soft leaves, and lax areolation resembling that of Splachnaceae. Capsule globose, oval or pyriform, erect and symmetrical or cernuous and unequal, usually with a distinct neck narrower than the capsule ; cleistocarpous, gymnostomous or peristomate. Inner peristome when present of 16 separate processes, entirely without a basal membrane, and opposite to, not alternating with the teeth. Calyptra usually inflated, smooth, with a long beak, lobed or cucullate.

Mosses resembling Splachnaceae in leaf structure, but differing in the often cernuous fruit, which, while frequently long-necked, does not possess an actual apophysis ; in the calyptra, and in the peristome, which when fully present is double and highly developed.

57. **DISCELIUM** Brid.

Plants *almost without stems*, resembling minute buds on the persistent protonema. Leaves *almost nerveless, sheathing*, without chlorophyll. Capsule *small, inclined, sub-globose ;* peristome *single*. Calyptra *narrow*, split on one side, very narrow at base.

A genus consisting only of the following remarkable plant, which in fruit resembles Catoscopium, but in areolation the present Order. The peristome also is somewhat anomalous, with a superficial resemblance to that of Trematodon ; but it is in structure Funarioid.

Deriv.—δι-(di) two, and σκελος (skĕlos) a leg ; from the two branches of the peristome teeth.

1. Discelium nudum Brid. (*Bryum nudum* Dicks.) (Tab. XXXV. F.).

Stem *minute, bud-like*, brownish green, annually formed on a perennial protonema. Leaves few, small, ovate-lanceolate, entire or faintly and obtusely toothed, *nerveless or with a faint trace of a thin nerve in the upper part ;* cells lax, hexagonal-oblong, pellucid. Seta about an inch long, slender, reddish ; capsule *minute, sub-globose*, suddenly bent at the short neck, and *horizontal ;* lid convex ; annulus broad. Peristome teeth 16, cleft half-way from the base upwards, undivided above. Dioicous.

Hab. Clay banks, rare. Fr. early spring.

A very curious plant, quite unlike any other of our species of moss, though resembling Catoscopium in the form of the fruit. It is most conspicuous, except when the fruit is maturing, by the densely matted protonema covering the bare soil. Multicellular, tubercular gemmae occur on the radicles.

58. **NANOMITRIUM** Lindb.

Resembling Ephemerum, but differing in the presence of a *rudimentary lid*, and in *the absence of a spore-sac*, the capsule almost without apiculus, the calyptra usually *very minute*. Stomata *none*. Leaves laxly areolated, nerveless.

The plants included under this genus, though superficially resembling Ephemerum, are rightly separated on account of the above structural differences of some considerable importance. In Ephemerum the capsule is always more or less differentiated into outer case and spore-sac, the enveloping membrane consisting at least of two layers ; in Nanomitrium there is only a single layer of cells, thus representing an even simpler form than Archidium ; and the only approach to an apiculus is a single cell, or at the most three or four, forming a slight thickening at the summit of the capsule.

A ring of small differentiated cells round the upper part of the capsule forms a "line of least resistance" where, upon a slight pressure, the upper part separates in the form of a lid. (E. S. Salmon, Journ. of Linn. Soc., Bot., vol. xxxiv., p. 163.)

DERIV.—*νανο*-(nano) dwarf, and *μιτριον* (mitrion) a cap ; from the minute calyptra.

1. **Nanomitrium tenerum** Lindb. (*Phascum tenerum* Bruch ; *Ephemerum tenerum* C.M., Schp. Syn) (Tab. XXXV. G.).

Plants *very minute*, on a persistent protonema. Leaves few, *ovate-lanceolate*, tapering, *nerveless, entire or very slightly and obtusely serrate above ;* cells *large* and thin-walled, 20–25 μ wide, rectangular-rhomboid. Capsule immersed on a very short, slender seta, almost globose, when fresh minutely apiculate, *pale brown ;* calyptra very minute ; spores *rather small, 20–30* μ, sub-tetrahedral. Synoicous.

HAB. On mud taken from a fish pond near Hurstpierpoint, Sussex, 1854 (*Mitten*) ; near Crowborough, Sussex, 1896 (*Nicholson*) ; Kent. Fr. late autumn.

A very minute plant ; the protonema is less persistent and less conspicuous than in *Ephem. serratum*, though the individual stems are somewhat larger and more distinct. The apiculus is easily seen in the fresh capsule, though minute, but mostly disappears upon drying. The nerveless leaves distinguish it from all the species of Ephemerum but *E. stellatum*, *E. serratum*, and its sub-species *E. intermedium*, the nerve of which is sometimes very indistinct ; the almost entire leaves will separate it from the last two, and the smaller spores, thin capsule, and synoicous inflorescence from all three.

59. **EPHEMERUM** Hampe.

Minute, annual, terrestrial plants developed on a *persistent, much branched, green protonema.* Leaves more or less ovate-lanceolate, usually tapering, with rather lax areolation, more or less rhomboid. Capsule *immersed, cleistocarpous*, rounded, minutely apiculate, *the wall of two layers of cells ;* spores large ; calyptra small, thin, *campanulate*, torn at the base, sometimes on one side only ; stomata present.

The plants composing this and the last genus are connected with the higher Funariaceae through Physcomitrella and Physcomitrium in much the same way as Phascum is linked with the more highly developed Pottia by *P. recta* and *P. bryoides ;* and also as the cleistocarpous species of Weisia are connected with the higher species, through *W. rostellata.*

The persistent protonema may be in part a storehouse of moisture, but is probably of more importance in preventing other plants from occupying the soil and thus crowding out the Ephemerum. It is often more conspicuous than the stems themselves, and leads to their discovery where they would otherwise be overlooked.

DERIV.—ἐφημερος (ephēmeros), short-lived.

1 { Leaves nerveless 2
  { Leaves nerved, at least near apex 3

2 { Ls. narrowly pointed, sharply toothed ..... *1. serratum*
  { Ls. widely pointed, obscurely denticulate ..... *2. stellatum*

3 { Nerve faint, wanting in lower half of leaf ..... *1*. intermedium*
  { Nerve distinct throughout 4

4 { Leaves broadly lanceolate, nerved to apex ..... *3. cohaerens*
  { Leaves narrow, nerve excurrent 5

5 { Ls. lanceolate-subulate, tapering, almost entire ..... *4. sessile*
  { Ls. ligulate, toothed at apex ..... *5. recurvifolium*

1. **Ephemerum serratum** Hampe (*Phascum serratum* Schreb.) (Tab. XXXV. H.).

Minute, gregarious, with green persistent protonema. Leaves few, erecto-patent, usually slightly flexuose or curved above, *lanceolate, tapering to a narrow point :* margin *coarsely and irregularly toothed* above ; nerve *none ;* cells lax, hexagonal-rhomboid, elongate, 5–8 times as long as wide (100–150 μ in length, 15 24 μ wide) in upper two-thirds of leaf, at apex equally narrow, the walls a little incrassate, at base paler, thin-walled. Capsule immersed on a very short seta, sub-globose, apiculate, *bright chestnut-brown, glossy ;* calyptra small, widely campanulate, torn at base ; spores *large*, 60-80 μ, coarsely or finely papillose ; stomata confined to the base of the capsule. *Dioicous ;* male plant small.

Var. β. *angustifolium* B. & S. (*E. minutissimum* Lindb., Braithw. Br. M. Fl.). Leaves *narrower*, often subsecund; spores *rather smaller*, very finely papillose.

Hab. Fallow fields and bare spots; not infrequent. The var. β rare; S.E. England; Lancashire; N.E. Ireland. Fr. late autumn.

The var. β has a distinct appearance when it is well marked, but I do not think it has any title to specific rank. The spores run to 60 μ in Mitten's original plant and frequently up to 70 μ and 80 μ in others; they are as a rule less papillose, but certainly are not smooth in ripe specimens. Mitten writes that he did not consider it smaller than *E. serratum*, but always thought it larger; indeed, it was the size that first struck him in the earlier specimens. I am inclined to think that it is rendered more conspicuous by the relative development of the capsule in contrast with the smaller, narrower leaves, without any marked or constant difference in actual size. Mr. J. H. Davies sends me the variety well marked from several stations in N.E. Ireland, but showing the same want of constancy and tendency to approach *E. serratum*.

* **Ephemerum intermedium** Mitt. (Tab. XXXV. I.).

Differs from *E. serratum* in the presence of a *faint nerve in the upper part of the leaf*, very thin and obscure, and vanishing above the middle, but occupying the greater part of the point; upper cells *narrower*, rather long.

Hab. Fallow fields, Sussex; very rare. Fr. late autumn.

The difference between this and *E. serratum* depending entirely upon the nerve, which is sometimes extremely faint, and in the lower leaves always wanting, and upon a slight difference in the width of the cells, which are somewhat variable in *E. serratum*, I have thought it best to consider *E. intermedium* as a sub-species only of the former. The nerve is chiefly recognisable by the deeper chlorophyllose colour it gives the apex of the leaf. Mr. Nicholson finds it vary considerably in the degree of its development among plants from the same spot.

2. Ephemerum stellatum Philib. (Tab. XXXVI. A.).

Exceedingly minute. Leaves numerous (about 20), *rigidly divergent in a stellate arrangement*, from a *turgid oval* base abruptly contracted to a *narrowly oblong* limb, *not finely acuminate, but quickly narrowed to a short, broad, acute point;* concave at base, *flat* above, and straight, *not curved or flexuose;* nerveless; margin *sub-entire or slightly denticulate*, not sharply serrate; basal cells *large*, thin-walled, pellucid, *each containing one or more large oil-globule*, cells in middle and upper part of leaf incrassate, smaller than in *E. serratum* (70–100 μ by 12–18 μ), 5–6 times as long as wide, at apex *much shorter*, but little narrowed, 2–4 times as long as wide; capsule slightly smaller and more elongate than in *E. serratum*, otherwise resembling it, calyptra *rather large*, covering

more than half the capsule, campanulate, lobed at base. Seta rather longer, spores *smaller*, 40–50 μ, *smooth*. Male flowers on short stems near the base of the fertile plant or distinct.

HAB. Sandy clay soil, Crowborough, Sussex, and Bedgbury Park Woods, Kent (*W. E. Nicholson*).

Probably the most minute of our British mosses. Quite distinct from *E. serratum* and all our other species by numerous and, I think, stable characters; the rigid stellate habit, most noticeable in the young plants, is alone quite distinct, and only approached by *E. sessile* var. *brevifolium*, which is at once distinguished by its nerve. The outline of the leaves, the sub-entire margin, and the much shorter apical cells are very marked and characteristic. The base of the leaf is often much thickened, especially in young plants, and serves for the storage of food material; the large, highly refractional globules are very conspicuous.

The leaves somewhat resemble those of *Nan. tenerum* in outline, but the cells are smaller and much more incrassate, and the spores twice as large.

3. Ephemerum cohaerens Hampe (*Phascum cohaerens* Hedw.) (Tab. XXXVI. B.).

Stems closely tufted, protonema bright green, becoming discoloured when older. Leaves *oblong-lanceolate or ovate-lanceolate, finely pointed*, serrated in upper part; nerve thin, strong in acumen, *reaching apex or vanishing just below;* cells rhomboid-hexagonal, rather smaller than in *E. serratum*, but larger than in the two following species. Calyptra *lobed or torn at base*. Stomata distributed over the whole surface of the capsule. Spores as large as in *E. serratum*, rather coarsely tuberculate. Dioicous.

HAB. Moist banks; near Portumna, Galway (*Moore*); Arundel, Sussex, 1895 (*W. E. Nicholson*). Fr. late autumn.

Differing from the next in the broader, more serrated leaves and not or indistinctly excurrent nerve; from *E. recurvifolium* in the more lanceolate outline of the leaves, shorter nerve and larger cells. The presence of a well-developed nerve distinguishes it from the preceding plants. The apex of the leaf is often slightly oblique or recurved.

4. Ephemerum sessile Rabenh. (*Phascum sessile* B. & S., *Ephemerum stenophyllum* Schp., Syn., Braithw. Br. M. Fl., etc.) (Tab. XXXVI. C.).

Rather taller than *E. serratum*, with longer leaves, the upper lanceolate-subulate, *gradually tapering to a narrow point*, very slightly serrulate at apex; *nerve thin at base, broad* (about $\frac{1}{3}$ width of leaf at base), *slightly excurrent*. Upper cells *small*, irregularly rectangular-rhomboid, incrassate. Calyptra *torn at base*. Stomata as in *E. cohaerens*. *Autoicous*. Male flower at the base of the stem.

Var. β. *brevifolium* Schp. Leaves *shorter, nearly entire;* nerve less excurrent.

HAB. Open places, rare. Sussex; Kent; Cheshire. The var. *β*, Mere, Cheshire; Crowborough, Sussex. Fr. late autumn and winter.

There has been much confusion between this and the next species; but the linear, not tapering leaves of that plant, its still smaller cells, and calyptra cleft along one side, easily distinguish it. The present species is more easily, perhaps, confused with the last, but has more gradually tapering, narrower, less strongly serrate leaves, smaller cells and more excurrent nerve.

5. Ephemerum recurvifolium Lindb. (*Phascum recurvifolium* Dicks.; *Ephemerella recurvifolia* Schp., Syn.) (Tab. XXXVI. D.).

Protonema dull green, disappearing when the capsules are about matured. Leaves erecto-patent, *straight or recurved towards apex, ligulate or linear, often wider in the upper half than in the lower, shortly pointed:* margin slightly denticulate above, sometimes more strongly at apex; nerve *narrower* (about $\frac{1}{5}$ width of leaf at base) than in the last, but more clearly defined and stronger, reaching to apex and usually slightly excurrent. Cells at base thin, hyaline, rectangular, above smaller, irregularly rhomboid, *not so large as in the previous species.* Seta short; capsule globose-oval, with a short *oblique* apiculus, thick-walled. Stomata at base of capsule only. Calyptra larger than in the previous plants, *split on one side only.* Dioicous.

HAB. Fallow fields, etc., rare. Fr. late autumn and winter.

If attention be paid to the form of the leaf, *E. recurvifolium* need not be confused with the other nerved species; the nerve in this being stronger, and though narrower than in the last, more clearly defined; and the outline of the leaf being almost exactly ligulate. The leaves are generally more or less spreading and recurved, so that the capsule is rendered quite conspicuous, though the seta is very short.

60. PHYSCOMITRELLA B. & S.

Minute plants, *without persistent protonema.* Leaves nerved, the upper forming a terminal rosette, laxly areolated. Capsule on a short seta, *usually splitting horizontally by* a circular fissure about midway between top and bottom, *sub-globose*, apiculate. Calyptra narrowly campanulate.

Intermediate between Ephemerum and Physcomitrium. The stem though short is well developed, the seta is frequently somewhat elongated, the columella is more highly differentiated than in Ephemerum, and the ripe capsule shows a distinct tendency to split regularly round, at or near the middle; a certain differentiation in the cells of its membrane may be seen at this

line, compared with those above and below, though I have not been able to find it so clearly marked as in the specimen described and figured by Mrs. Britton (Bulletin, Torrey Bot. Club, Vol. 22, No. 2, pp. 62 sqq.).

DERIV.—Diminutive of Physcomitrium.

1. Physcomitrella patens B. & S. (*Phascum patens* Hedw.) (Tab. XXXVI. E.).

Stems very short, *about 1 line in length*, densely or loosely gregarious. Leaves variously shaped, oblong, oval, or spathulate, shortly and usually obtusely acuminate, the upper larger, forming a terminal rosette; rather obtusely serrate, nerve narrow, vanishing below apex; cells lax, widely rectangular or hexagonal. Capsule *immersed or slightly emergent*, brown, thin-walled, *globose with an obtuse apiculus*. Spores rather smaller than in the previous genus, 25–30 μ, papillose. Paroicous. Antheridia usually just below the fertile flower.

Var. β. *Lucasiana* Schp. Stem *shorter;* leaves more crowded, *shorter and broader.*

HAB. Sides of pools, clay fields, etc., not common. The var. β, Herts.; Chapel-en-le-Frith, Derby (*Barker*); Cheshire; South Lancs. Fr. autumn.

A larger plant than any of the previously described allied species, with larger, broader leaves and wider cells. Perhaps it is more likely to be confused with *Phascum cuspidatum*, but that has entire leaves with the margin recurved, and the cells only about half the size.

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61. PHYSCOMITRIUM Brid.

Plants resembling the erect-fruited species of Funaria; calyptra small, *covering about half the capsule*, fugacious, *symmetrical, 2–3-lobed* (rarely more) at base. Capsule *erect, symmetrical*, lid *apiculate or rostellate*, the cells arranged in *straight lines* from the centre to the circumference, peristome *none*.

This genus stands in the same relationship to the other Funariaceae that Pottia occupies towards the rest of the Tortulaceae. A continental species, *P. tetragonum* (*Pyramidula tetragona* Brid.) still more closely fills the gap between Ephemerum and the higher forms, having the capsule hardly raised above the perichaetial bracts.

The small, lobed calyptra, not oblique, inflated, nor cucullate, is the main character of distinction between the present genus and the next.

DERIV.—$\phi\upsilon\sigma\kappa\eta$ (physce) a bladder, and $\mu\iota\tau\rho\iota\upsilon$ (mitrion) a cap; a not very appropriate reference to the calyptra.

{Leaves almost entire ; capsule globose, wide-mouthed..... *1. sphaericum*
{Leaves serrate above ; capsule pyriform.....*2. pyriforme*

1. Physcomitrium sphaericum Brid. (*Gymnostomum sphaericum* Ludw.) (Tab. XXXVI. F.).

Stems very short, 1–2 lines in length, rarely more than a line. Leaves close, erecto-patent, broadly obovate, concave, *obtuse, entire, or faintly irregular* with the protruding marginal cells ; nerve vanishing below apex ; cells lax, hexagonal-rectangular. Seta about *1½ lines* in length, capsule *small, spherical*, with an obtusely apiculate lid, after the fall of the lid *widely turbinate, broader than long, with a very wide mouth, brown*. Spores 25–30 μ, papillose. Calyptra narrow, conical, about 4-lobed at base. Autoicous.

Hab. Dried mud in beds of pools, very rare. Cheshire ; Derbyshire ; Staffordshire ; Surrey. Fr. autumn.

This rare and pretty little moss sometimes grows with *Pottia truncatula*, small specimens of which might easily be taken for it. In that, however, the capsule is always longer in proportion to its width, the leaves are not concave, and the nerve is longer.

Like many of the annual mosses, this species has a habit of disappearing from its localities and re-appearing after a lapse of some years.

2. Physcomitrium pyriforme Brid. (*Bryum pyriforme L.*) (Tab. XXXVI. G.).

Closely gregarious, often in wide patches, bright green, taller. Leaves *rather large*, erecto-patent or spreading, concave, ovate, or from a narrow base obovate, *somewhat acute, serrate above*, nerve vanishing at apex, narrow, distinct ; cells large, at base rectangular, becoming more hexagonal-rhomboid towards the summit, narrower towards margin. Calyptra erect, finally 4–5 lobed, the lobes divaricate. Seta *3–5 lines* long, red ; capsule variable in form, *larger, roundish-oval or oval-oblong*, with a rather short but distinct neck, the whole usually pyriform when dry, the capsule often, but not always, slightly contracted below the *rather narrow* mouth ; lid convex, apiculate, usually distinctly rostellate, the cells in straight lines from apex to margin ; annulus broad, fugacious. Autoicous.

Hab. Clay banks and heaps of mud thrown out of ditches, etc. Common. Fr. spring.

There is no difficulty in distinguishing this species from the last ; the greater size of all its parts, the larger and longer capsule with a much narrower mouth, easily identifying it. It has much greater resemblance to *Funaria fascicularis*, but may be distinguished without much difficulty by the following characters. The lid in the present species is always distinctly apiculate,

usually with a longish beak, while in that it is plano-convex, and the cells are also somewhat spirally arranged, in our plant being in straight lines. The calyptra while immature is very similar in both, but while in the present species it remains erect and becomes many-lobed at the base, in the Funaria it becomes oblique, the basal part remaining inflated and entire except for a single lateral fissure. The broad, separating annulus is also a marked character in the present species.

62. **FUNARIA** Schreb.

Short-stemmed plants resembling Physcomitrium in the vegetative part; leaves rather wide, with large cells. Calyptra *inflated at base, covering most of the mature fruit, finally oblique, cucullate, otherwise entire at base*, yellowish. Capsule pyriform, *erect and symmetrical or oblique and curved*. Lid *plano-convex, rarely distinctly apiculate*, the cells arranged in somewhat *spiral lines* (rarely straight) from the centre to the circumference. Peristome none, single or double; outer teeth 16, often twisted obliquely to the left, sometimes united at their tips; *inner peristome when present of 16 processes opposite the teeth, without a basal membrane*. Autoicous in all the British species; male flower *discoid*, terminal on a lateral branch.

The species included in the section Entosthodon, which I have here united, following Braithwaite and Lindberg, with Funaria, have been tossed about from one genus to another; but clearly there is nothing gained by splitting up the genus, since any distinction based on the peristome separates species allied by the form of the capsule, and *vice-versa*; on the other hand the affinity with Physcomitrium is very close and the question seems rather to be whether even that is rightly kept separate from Funaria; here, however, we have a real distinction in the calyptra, and a consistency, at least in the former genus, in the form of capsule and absence of peristome.

DERIV.—Lat. *funis*, a cord, from the seta in *F. hygrometrica* spirally twisted when dry.

1 { Capsule erect, symmetric or almost so.....2
  { Capsule inclined, mouth oblique.....4

2 { Capsule short, obovate; peristome rudimentary.....3
  { Capsule clavate-pyriform; peristome perfect.....*3. Templetoni*

3 { Leaves bordered.....*2. ericetorum*
  { Leaves not bordered.....*1. fascicularis*

4 { Seta straight; ls. with long fine acumen.....*4. calcarea*
  { Seta arcuate when moist; ls. acute or shortly acuminate.....5

5 { Capsule deeply furrowed when dry, mouth large; lid convex; spores about 15 μ.....*5. hygrometrica*
  { Capsule less furrowed, mouth very small; lid usually mamillate; spores about 25 μ.....*6. microstoma*

A. ENTOSTHODON.

Capsule nearly or quite symmetrical, erect ; peristome none or single, rarely double.

1. Funaria fascicularis Schp. (*Bryum fasciculare* Dicks. ; *Physcomitrium fasciculare* Fuernr., mult. auct.) (Tab. XXXVI. H.).

Resembling *Physcomitrium pyriforme*, but usually a rather more slender and paler plant. Leaves rather narrower, ovate-lanceolate and oblong-spathulate, acuminate and acute. Cells as in that species, *the marginal hardly distinct*. Seta pale reddish, capsule erect or very slightly inclined, *brown, rounded-oval*, pyriform with the shortly tapering neck ; calyptra shining, yellowish green ; lid *plano-convex, often quite flat when dry, the* cells arranged *in slightly oblique series* with a tendency to a spiral arrangement ; annulus none. Peristome *none*, or rudimentary, consisting of minute projections from the orifice.

HAB. Fallow fields, etc. ; not common. Fr. spring.

In addition to the strongly marked characters mentioned under *Physcomitrium pyriforme*, by which that species is distinguished from the present, *Funaria fascicularis* differs in its paler colour, and in the narrower leaves and generally more slender habit. From the next species it may be known by the non-margined, more serrate leaves, and capsule of a duller colour and rather larger size.

2. Funaria ericetorum Dixon (*Gymnostomum ericetorum* Bals. and De Not. ; *Entosthodon ericetorum* C.M., Schp. Syn. et plur. auct. ; *Funaria obtusa* Lindb., Braithw. Br. M. Fl.) (Tab. XXXVI. I.).

Loosely tufted, stem less than half-an-inch in height ; leaves yellowish green, slightly glossy when dry, the upper crowded, rather narrowly oval or oblong-lanceolate, acute, sub-entire or slightly denticulate above, nerve ceasing some way below the point, more rarely reaching it ; cells at base lax, rectangular, above hexagonal-oblong, 1-2 rows at margin very narrow, incrassate, orange, *forming a distinct border*. Seta *2-3 lines long*, slender ; capsule resembling that of the last species, but *smaller, of a brighter reddish colour*, and more glossy, of a solid, opaque texture. Lid convex, or very slightly mamillate ; cells in straight, not oblique lines. Peristome *extremely rudimentary, or obsolete*.

HAB. Shady banks, etc., chiefly in mountainous country. Not unfrequent. Fr. spring.

The distinctly margined leaves and smaller capsule separate this with ease from the last species, in which though occasionally a single marginal row

of cells is distinctly narrower and a shade yellower than the rest, there is never found a distinct border; the nerve, too, in that species is almost always carried further towards the point than in this. The narrow fruit with longer neck and well-developed peristome of the next species readily distinguish it from the present one.

F. ericetorum presents considerable variation in the width of the leaves, and in the form of the ripe capsule, which is sometimes markedly urceolate from constriction below the wider orifice, but sometimes shows no trace of this.

3. Funaria Templetoni Sm. (*Entosthodon Templetoni* Schwaeg., Schp. Syn., et plur. auct.; *Funaria attenuata* Lindb., Braithw. Br. M. Fl.) (Tab. XXXVI. J.).

Stems laxly gregarious or tufted, ½–inch in height or less. Upper leaves forming a rosette, spreading, when dry erect and slightly twisted, and glossy; obovate-oblong, *shortly, sometimes very abruptly acuminate*, rather concave, nerve ceasing below the apex; cells rather wider than in the last, the marginal narrower, forming a distinct but less pronounced border; cells at margin obtusely protruding above, but not forming acute serratures. Seta *3–5 lines long*, pale red, slender, flexuose; capsule yellowish green with a red mouth, finally reddish brown, *narrow, oval-oblong, with a long tapering neck*, erect or slightly curved, contracted below the mouth when dry; lid plano-convex, or very slightly mamillate; *annulus none;* peristome *simple*, of 16 *short, lanceolate-subulate*, reddish brown, distant teeth, articulate, inserted below the orifice, incurved and flattened over the mouth of the capsule when dry, rather fugacious.

HAB. Shady banks and clefts of rocks near water; not uncommon in mountainous districts. Fr. summer.

A pretty species, conspicuous by its capsules of a reddish tinge (especially in the upper part), which are also much narrower in outline, and, including the neck, much longer and more gradually tapering below than in the last two species; it also ripens its fruit later in the year. The fruit is often somewhat curved and asymmetrical; almost always a little contracted below the mouth, thence equal for some distance or widening again, or gradually tapering to the neck. The border of the leaves is distinct, but not so strongly marked as in the last. The peristome is often very fugacious.

B. EU-FUNARIA.

Capsule oblique, curved, asymmetrical; peristome present.

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4. Funaria calcarea Wahl. (*F. Muehlenbergii* Turn. and *F. hibernica* Hook., Wils. Bry. Brit.) (Tab. XXXVII. A.).

Loosely tufted, stems not half-an-inch in height. Upper leaves crowded, oval or obovate, *rather suddenly acuminate in a*

long piliform point, entire or denticulate above; nerve vanishing below apex; cells hexagonal-rhomboid, narrower at margin. Seta *erect*, reddish, rigid; capsule shortly pyriform, *gibbous at back, slightly curved*, with a tapering neck, brownish yellow, finally reddish and slightly contracted below the mouth, *smooth*; neck somewhat plicate when dry; *annulus none*; lid conical-convex, *slightly mamillate*; peristome *double*, outer of 16 narrowly lanceolate, red, obliquely curved teeth, inner of 16 processes shorter than the teeth.

Var. β. *patula* B. & S. *Taller and more slender*; leaves *entire*, with shorter points.

Hab. Calcareous rocks and walls, rare. The var. β with the type. Fr. spring.

A somewhat variable moss in the serration of the leaves and other points. It differs from the following in the almost piliferous leaf-point, the straight, erect seta, the smooth capsule with straight, not oblique mouth, below which the capsule is constricted, though slightly: in the more pointed lid and narrower peristome teeth, and especially in the absence of annulus.

5. Funaria hygrometrica Sibth. (*Mnium hygrometricum* L.) (Tab. XXXVII. B.).

Stems about ½-inch in height, loosely or closely tufted, in large patches, pale yellowish green. Upper leaves imbricated into a bulbiform tuft, concave, large, widely oval-oblong, *shortly pointed*, entire or nearly so, nerved to apex; cells sub-hexagonal, a little narrower at margin. Seta long (*1–2½ inches*), flexuose, variously *arcuate* when young, finally reddish, flexuose, strongly twisted and hygroscopic when dry; capsule pyriform, unequal, gibbous at back, inclined, *strongly incurved at mouth, deeply sulcate when dry*, yellow, the mouth deep red; finally brown; *annulus broad*; lid convex, large. Peristome teeth closely and obliquely arranged in a spiral turn, the apices united by a small disc; processes shorter than the teeth. Spores rather small, 12–15 μ. Autoicous, male flower discoid, with spreading bracts.

Var. β. *arctica* Berggr. Seta shorter; capsule *less furrowed*; mouth rather smaller; spores *larger, 18–27* μ. Peristome somewhat imperfect.

Hab. Heaths, banks, etc., especially where the ground has been burnt. Common. The var. β rare; Beeston Regis, Norfolk, 1898 (*Burrell*). Fr. all summer.

This common and well-known moss is very variable, but never presents any difficulty in its recognition except with regard to the two allied species, *F. calcarea* and *F. microstoma*. The former is easily known as pointed out above; the latter differs in the narrow mouth, larger spores, and rudimentary inner peristome, but the var. *arctica* closely resembles it. The lid, also, is more conical, but *F. hygrometrica* is occasionally found with projecting, conical lid.

The mouth is remarkably oblique, often becoming almost parallel with the axis of the capsule. The lid, peristome, etc., afford beautiful microscopic objects. A form occurs with the leaves distinctly toothed above.

The var. *calvescens* B. & S. seems to be simply a luxuriant form developed under moist favourable conditions, often passing into the type, and scarcely differing from it except in the greater size of some of its parts. I have, therefore, omitted it.

Mrs. Britton and Mr. R. S. Williams, to whom the Beeston Regis plant was sent as possibly *F. flavicans* Michx., a N. American species, refer it to *F. hygrometrica* var. *arctica* Berggr. A marked feature is the large spores, almost equalling those of *F. microstoma*, but the mouth of the capsule is not quite so contracted. Dr. Hagen states that *F. hygrometrica* in Norway, while otherwise scarcely differing from the normal form, usually has the spores 18-27 μ. The variety can therefore hardly be considered a very well-defined one, but it is interesting as forming a connecting link with *F. microstoma*. The processes of the inner peristome are sometimes entirely adherent to the outer teeth in the Norfolk plant.

6. Funaria microstoma B. & S. (Tab. XXXVII. C.).

Resembling the last. Leaves a little more longly acuminate. Capsule on a *shorter seta*, cernuous, *less strongly sulcate, the mouth very small, less oblique*, the lid *more conical and pointed ;* peristome smaller, *the inner imperfect or rudimentary*. Spores *rather larger, 24–30 μ.*

HAB. Heaths, sides of ponds, etc. Rare. Fr. late summer.

The existence of the true *F. microstoma* in Britain is exceedingly doubtful. Hunt's specimens at Kew are clearly *F. hygrometrica*, and so, as Mr. Nicholson informs me, are Davies's at the British Museum. The continental plant is generally a high alpine species, and is well marked in its small capsule-mouth and large spores.

ORDER XV. MEESIACEAE.

Plants usually inhabiting bogs, of varying habit and leaf-form ; the leaves usually of firm texture and rather small areolation (except in Amblyodon). Capsule on a long seta, more or less clavate with a long neck, curved or inclined, smooth or striate. Peristome double, the inner as long as or longer than the outer, of 16 narrow processes alternating with the teeth, with or without intermediate cilia, from a membrane of variable height usually united, below each process, with the outer teeth.

The genus Amblyodon, here included, is by Lindberg placed among the Funariaceae, and in this he is followed by Braithwaite. The leaf-structure is distinctly that of Funaria, and it is with reluctance that I have felt obliged to retain it here ; but the form of the fruit is that of the present Order, and the structure of the

peristome is so distinctly that of Meesia, and so markedly different from that of the Funariaceae, that the anomaly of uniting it with the latter Order must, I think, be considered far greater than that of separating it.

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63. **AMBLYODON** P. Beauv.

Plants with the fruit resembling Meesia and the leaf-structure of Funaria. Capsule (with the neck) *clavate-pyriform, curved and asymmetrical;* peristome double, outer of 16 *short, rather obtuse*, articulate teeth; inner of 16 *longer*, lanceolate processes, *alternating with the teeth*, sometimes connected above by transverse appendages; rudimentary intermediate cilia sometimes present; basal membrane short. Calyptra small, cucullate.

DERIV.—ἀμβλυ (ambly) blunt, and ὀδους (odous) a tooth.

1. Amblyodon dealbatus P. Beauv. (*Bryum dealbatum* Dicks.) (Tab. XXXVII. D.).

Stems ½–1 inch high, slightly branched; leaves more or less crowded in comal tufts, *longly ovate-lanceolate or oblong-lanceolate*, shortly pointed; when dry slightly twisted, glossy; of thin texture, entire or slightly denticulate above; margin *plane;* cells *lax*, resembling those of Funaria, lower rectangular, thin, pellucid, upper *hexagonal-rectangular, thin-walled, smooth;* nerve *very strong*, sometimes half the width of the leaf at base, narrowing upwards and vanishing below apex. Seta red, 1½–2 inches long; capsule oval-cylindrical, gibbous at back, *curved, when dry arcuate, from a narrow, tapering, erect neck*, reddish brown, *smooth;* lid conical, obtuse; calyptra narrow, fugacious, annulus narrow; outer teeth reddish, *linear*, variable in length, sometimes only half as long as the pale yellow inner peristome.

HAB. Boggy places and springs, often calcareous, usually in alpine and sub-alpine districts, not common. Fr. summer.

The smooth, curved and oblique, asymmetrical capsule with tapering neck, is not like that of any others of our mosses except Meesia and Paludella; the similar species of Splachnaceae having erect fruits, those of Funaria smaller and wider capsules on shorter setae, and usually striate, with different peristome, while Aulacomnium is separated by its striated fruit and small areolation; the latter character and the narrow, lingulate leaves easily distinguish *Meesia trichoides*, which in fruiting characters much resembles the present species; the capsule is, however, a little shorter and wider, and less curved, than in the present plant.

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64. **MEESIA** Hedw.

Stems short or tall, leaves in 3–8 rows, *with a thick nerve ;* cells *rather small, smooth, rectangular or rectangular-hexagonal,* seta long, capsule as in Amblyodon ; male inflorescence discoid.

DERIV.—After David Meese, a Dutch gardener.

1. Meesia trichoides Spruce (*Bryum trichoides* L. ; *Meesia uliginosa* Hedw., Schp. Syn. et plur. auct.) (Tab. XXXVII. E.).

In dense, pale green glossy tufts, radiculose below. Leaves in 8 rows, the upper longer, *linear, or ligulate-lanceolate,* at apex *rounded and obtuse ;* when dry erect, hardly twisted, *shining ;* margin *revolute, entire,* nerve *very strong and thick,* occupying *the greater part of the lower half of the leaf,* vanishing just below apex ; cells at base *linear,* 4 6 times as long as broad, similar in form but gradually shorter upwards, a few at apex hardly longer than broad ; all *small, narrow, smooth,* with the walls slightly incrassate. Seta variable in length, $\frac{1}{2}$–$1\frac{1}{2}$ inches long ; capsule *oval, gibbous at back, inclined and slightly curved, from an erect tapering neck ;* lid conical, obtusely pointed. Outer peristome teeth *short, oblong-lanceolate, obtuse ;* much shorter than the processes of the inner.

Var. *β. alpina* Boul. (*Meesia alpina* Funck). Leaves *somewhat narrower, acute or sub-acute ;* stems usually taller and seta longer ; capsule rather shorter.

Var. *γ. minor* Boul. (*Meesia minor* Brid.). Stems short ; leaves *short, erect, obtuse,* broadly ligulate ; *capsule and neck shorter.*

HAB. Boggy ground on mountains ; Scotland and North of England ; not common. The vars. *β* and *γ* on Ben Lawers. Fr. summer.

Although a somewhat variable moss, chiefly in the size of its various parts, this species is always a very distinct one, and may readily be known by the form of the capsule and the narrow, lingulate, more or less obtuse leaves, with very thick broad nerve. The varieties are only the extremes of a series of intermediate forms, and even on normal plants leaves may often be found with the apex somewhat acute or obtusely pointed.

There are three other European species ; one, *M. triquetra,* a very fine one, with lanceolate, acute leaves arranged distinctly in three rows, is fairly common over most of the north of Europe, and might possibly be found here.

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65. **PALUDELLA** Ehrh.

Stems tall, tomentose below. Leaves in five rows, *decurrent, squarrose,* cells *hexagonal-rounded, papillose,* rectangular

at base. Capsule on a *long* seta, slightly curved from an erect neck, *clavate-oblong*, *smooth*. Peristome resembling that of Webera, without cilia. Dioicous.

A very distinct genus consisting of a single species.

DERIV.—Diminutive of Lat. *palud-*, marsh; "The little marsh plant."

1. Paludella squarrosa Brid. (*Bryum squarrosum* L.) (Tab. XXXVII. F.).

In bright yellowish green dense tufts, 2–6 inches high, stems slightly branched, rather stout, *strongly tomentose below*. Leaves in five ranks, *strongly squarrose-recurved*, not much altered when dry, longly and narrowly *decurrent*, ovate-lanceolate from an erect oblong base, acute; margin narrowly recurved at base, *densely serrate above and plane;* nerve narrow, thin, vanishing below apex; cells at base narrowly rectangular, hyaline, above becoming *rounded-hexagonal*, *small*, incrassate, chlorophyllose, *strongly papillose*, the marginal rhomboid, projecting and forming the serratures. Perichaetial bracts spreading, not recurved, elongate-lanceolate. Seta reddish, *2–4 inches long;* capsule oval-oblong, slightly curved, from a rather short, not tapering neck, greenish brown, smooth; lid conical; calyptra cucullate.

HAB. Deep peat bogs, very rare and barren. Fr. summer.

It was much feared that this beautiful and exceedingly interesting species was extinct in Britain, the two localities in which it formerly occurred, Terrington Carr in Yorkshire and Knutsford Moor in Cheshire, having been altered by drainage. It was however discovered on Skipwith Common, Yorks, in 1916 (*J. Mennell*). In Scandinavia and Northern America it is common.

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66. AULACOMNIUM Schwaeg.

Caespitose mosses, with ovate or oblong-lanceolate leaves, with *small rounded papillose areolation*, each cell exhibiting a large conical papilla in the *centre* of its face; branches *frequently terminating in flagelliform pseudopodia*, naked or with a few minute leaves, and *bearing a cluster of gemmae* at the tip. Capsule oblong or sub-cylindric, *striate*, slightly inclined or curved. Peristome Mnioid, inner with long cilia.

This genus is usually placed near to Mnium, but in peristome it is not more closely allied to that genus than is Paludella, while in the form of the fruit and in areolation it seems more at home in the present Order.

DERIV.—*αὐλακο-*(aulako) furrowed, and Mnium. From the striate capsule.

1 { Plant under 1 inch ; ls. serrate, basal cells unistratose, not distinct from the rest ; pseudopodia numerous.....*3. androgynum*
Plant larger ; basal cells bi-tri-stratose, swollen ; pseudopodia less frequent... 2

2 { Ls. obtuse, imbricate, entire ; stems without radicles.....*1. turgidum*
Ls. usually toothed at apex ; stems matted with radicles.....*2. palustre*

1. Aulacomnium turgidum Schwaeg. (*Hypnum turgidum* Wahl. ; *Gymnocybe turgida* Lindb., Braithw. Br. M. Fl.) (Tab. XXXVII. G.).

In loose, bright or yellowish green tufts, pale below, *not tomentose*, 3–5 inches high, slightly branched, turgid. Leaves imbricated, when dry closely appressed, *soft, widely obovate, broadly rounded at summit*, very narrow at base, concave, somewhat cymbiform above, margin reflexed half-way from the base upwards, *quite entire ;* nerve narrowing upwards, ceasing below apex ; cells *below rectangular*, a few rows at base brown, above hexagonal-quadrate with sinuose, incrassate, strongly collenchymatous walls ; small, *smooth, or very faintly papillose*. Capsule ovate-oblong, *slightly curved*, striate, yellowish brown ; lid conical.

HAB. Among grass in damp places on mountains ; recently found on several of the Perthshire hills ; rare and sterile. Fr. summer.

This very rare and pretty species has only been found with us on Whernside in Yorkshire and on some few of the Scotch mountains. It can hardly be confused with any other moss except with the var. *imbricatum* of the next species ; from that it differs in the broader, rounded, very obtuse, softer leaves, the almost entirely smooth cells, and the absence of tomentum (on which account the stems readily fall apart.).

There is a slight inflation of the extreme basal angles of the leaf which produces the effect of minute auricles.

2. Aulacomnium palustre Schwaeg. (*Mnium palustre* L. ; *Gymnocybe palustris* Fries, Braithw. Br. M. Fl.) (Tab. XXXVII. H.).

Very variable in size and habit ; stems *robust*, loosely or densely tufted, 1–5 inches high, closely covered with brown tomentum almost to apex ; sparingly branched, pale yellowish green, rarely bright green ; leaves usually crowded, erecto-patent, when dry more or less crisped and spirally flexuose, or spirally appressed to stem or almost straight ; *long* (*1–2 lines*), *oblong-lanceolate or linear-lanceolate*, shortly pointed or obtuse, or gradually acuminate to a narrow point ; margin narrowly revolute at base, and to a variable distance above, towards apex *finely but sharply denticulate or sinuose-crenulate ;* nerve vanishing below apex, very white and shining at back when dry ; cells very small, irregularly rounded or angular, with thick, often sinuose, collenchymatous walls, towards base somewhat elongated, *a few*

rows at the extreme base wider, somewhat inflated, more or less bi-stratose, brownish yellow; all the cells except the basal *strongly but variably papillose* on both sides. Perichaetial bracts longer, narrower, more tapering, less papillose. Seta *1–2 inches long;* capsule oblong or sub-cylindrical, *slightly gibbous or curved*, cernuous, strongly sulcate; when dry contracted below the dilated mouth; lid conical; peristome teeth long, acute; processes of inner peristome about as long, with 3–4 intermediate cilia of equal length. Dioicous. Male flower terminal, *discoid*. Branches often producing flagelliform *pseudopodia, naked or with a few scattered minute leaves*, and bearing at the apex a cluster of small gemmiform metamorphosed leaves.

Var. β. *imbricatum* B. & S. Leaves crowded, *broader, wider at apex and more obtuse, entire or almost so, hardly twisted or quite straight and appressed* when dry.

Var. γ. *fasciculare* B. & S. (*Mnium fasciculare* Brid.). Stems *much branched with short branchlets*, leaves *in interrupted tufts*.

Var. δ. *laxifolium* Kindb., Cat. of Canadian Plants, p. 145. Leaves *distant, spirally flexuose and divergent, not appressed* when dry.

HAB. Bogs, common. The var. β not common; the var. γ in drier situations; the var. δ, Flitwick Marsh, Bedfordshire, 1887 (*Tuxon*). Fr. early summer.

A very variable moss, but not likely to be confused with many others; in its robust forms it has a great superficial resemblance to *Dicranum Bergeri*, but the areolation and the highly papillose leaves readily distinguish it from that plant; some forms, too, bear a likeness to *Mnium hornum*, which does not, however, inhabit the same localities, nor has it the shining nerve of the present species, and it is, of course, also readily known by its spinose leaves. *Aulacomnium turgidum* is on the whole the species most resembling it, and the var. *imbricatum* of the present plant sometimes approaches it so nearly that even under the microscope it is difficult to separate them; as a rule, however, that variety has the leaves more or less distinctly papillose, and they are, perhaps, never so wide, rounded and flaccid as is usual in *A. turgidum*.

Perhaps the most striking evidence of the great variability of *A. palustre* is to be found in the fact that while in their normal state no two mosses could well be more unlike than this species and *A. androgynum*, it sometimes occurs that dwarfed, slender forms of the first so nearly resemble taller plants of the last as to be with difficulty distinguished; I have specimens of *A. palustre* that are, indeed, in almost every respect similar to other fruiting specimens of *A. androgynum*.

The gemmiferous form of this species, usually known as var. *polycephalum* Huebn. (*G. palustris* var. *ramosa* Lindb., Braithw. Br. M. Fl.), emitting numerous pseudopodia from the axils of the leaves, is rather, I think, a state than a true variety. It is questionable, indeed, whether even the varieties given above are really more than forms arising from the direct action of certain conditions of the environment. Certainly I have specimens, the younger branches of which would have to be referred to the var. *imbricatum*, while the older leaves on the stems are quite of the typical form.

3. Aulacomnium androgynum Schwaeg. (*Mnium androgynum* L. ; *Orthopyxis androgyna* P. Beauv., Braithw. Br. M. Fl.) (Tab. XXXVIII. A.).

Stems *slender*, rarely 1½ inches high, slightly tomentose below, dull green ; usually producing slender *leafless pseudopodia*, ending in a round head of densely crowded stalked fusiform gemmae. Leaves *small, rarely 1 line long*, narrowly ovate-lanceolate or linear-lanceolate, when dry loosely appressed and slightly twisted, margin reflexed below, distinctly denticulate at apex ; cells *uniform or the lower a little elongated*, above rounded-quadrate or sub-hexagonal, incrassate, papillose ; perichaetial bracts longer, narrower. Seta ¾*-inch long ;* capsule erect, finally oblique or horizontal, *almost straight and symmetrical*, brown. Dioicous ; male flower terminal, *gemmiform*.

HAB. Banks and rotten tree trunks, frequent. Fruiting very rarely, in summer.

Usually at once recognisable by the numerous pseudopodia with minute balls of gemmae ; bearing some resemblance in this respect to *Tetraphis pellucida*, but at once known by the absence of the cup-shaped bracts, and also by the narrower leaves. Occasionally, as in the case of the specimens mentioned under the last species, it becomes taller, more radiculose, more robust, with longer leaves approaching those of *A. palustre* in form and even in areolation.

ORDER XVI. TIMMIACEAE.

Tall, robust mosses, resembling Polytrichum in habit ; stems very slightly branched. Leaves *long, narrow, serrate*. Capsule *symmetrical*, elliptical-oblong, with a tapering neck, inclined or horizontal, *hardly striate, but furrowed when dry*, Peristome double, outer as in Bryum, with dense articulations, inner with a basal membrane as in that genus, giving rise to cilia only, *in twos or fours, opposite to the teeth*, frequently appendiculate and sometimes united with one another.

67. TIMMIA Hedw.

Characters those of the Order.

The plants of this genus are very striking in their habit, which very greatly resembles that of Polytrichum, and the leaves, excepting in the narrower nerve and absence of lamellae, show a remarkable similarity to those of that genus both in form and structure. Besides the two British species there are two others known on the continent, one of which, *T. megapolitana* Hedw.,

has been recorded, apparently erroneously, from Ben Lawers. It differs from *T. austriaca* in the less sheathing whitish leaf-base, the nerve not dentate at back above, and the cilia of the inner peristome appendiculate.

DERIV.—After Timm, a botanist of Mecklenburg.

{ Leaves uniform, wide and sheathing at base, red at insertion...*1. austriaca*
{ Upper ls. much longer, scarcely sheathing, hyaline at insertion...*2. norvegica*

1. Timmia austriaca Hedw. (Tab. XXXVIII. B.).

Robust, 2-4 inches high, in dense tufts, dull green above, darker below, somewhat radiculose. Leaves large, *sub-equal*, 2-3 lines long, erecto-patent, appressed with the points twisted when dry; *from a wide, oblong, sheathing, orange base suddenly contracted*, then longly linear-lanceolate, tapering to a somewhat obtuse point, more or less concave or sub-tubular, margin plane or erect, serrate in the upper half, coarsely so near apex; nerve strong, often reddish, reaching apex, smooth or slightly dentate at back towards apex, *not papillose*. Cells of base orange, narrowly rectangular, pellucid, above very small, subquadrate-rounded, slightly incrassate, sometimes papillose. Capsule with the neck elongate-clavate, reddish-brown, lid hemispherical, apiculate; calyptra small, cucullate; peristome teeth pale yellow, cilia of the inner peristome not appendiculate. Dioicous.

HAB. Stony ground on mountains; very rare and sterile on two or three of the Scotch mountains. Fr. summer.

The most obvious characters by which this species is distinguishable in the field from the next, are the wide sheathing leaf-base and shorter, sub-equal leaves; under the microscope the nerve, not papillose at back or front above, readily separates the two; the dentation of the nerve towards apex is usually faint and may be quite absent.

2. Timmia norvegica Zett. (*T. scotica* Stirt. in Ann. Scot. Nat. Hist. xix, 238.) (Tab. XXXVIII. C.).

Resembling the last species, but differing in the leaves, which are *much elongated towards the summit of the stem*, 3-4 lines or even more, bright or yellowish green, forming a cuspidate tuft, arcuate and twisted when dry and frequently falcato-secund, sub-tubular, deciduous, *linear-lanceolate, hardly enlarged at the base or sheathing; nerve covered for the greater part of its length both at back and front with dense, ascending papillae*; not toothed at back. Cells above as in the last species, smooth or papillose, the basal elongated, chlorophyllose, usually *only a few of the lowest orange, two or three rows at the line of insertion very thin, fragile, hyaline*. Capsule resembling that of the last; cilia of inner peristome without appendages. Dioicous.

HAB. Mountain rocks and earth, very rare. The Ben Lawers group; Ben Heasgarnich; Powerscourt Waterfall, Ireland. Fruit not found in Britain.

Until recently the fruit of this species had not been recorded, and it has now only been found sparingly in the Tyrolese Alps. The characters italicised above will readily distinguish it from the last. The elongated leaves appear on the old stems alternately with the shorter ones, in interrupted tufts, and are usually falcato-secund. The leaves are very readily deciduous, owing to the delicate structure of the lowest rows of the basal cells. I have found this species on Ben Lawers and the adjacent mountains in many localities (sometimes forming large bright green tufts 5 or 6 inches high), but never in company with *T. austriaca*. Boulay suspects this to be a form of that species induced by great moisture, but that view seems, to say the least, improbable.

It is curious that the papillosity of the cells of the lamina in both these species should be so uncertain in character. As a rule the leaves are quite smooth, but one may be seen here and there with all the cells, except quite the basal ones, distinctly and even strongly papillose.

ORDER XVII. BARTRAMIACEAE.

Caespitose, usually tall and robust mosses, the stems often producing whorled innovations below the flowers. Leaves generally narrow in outline and acute, areolation narrow, usually sub-rectangular, almost always papillose. Calyptra small, fugacious, cucullate. Capsule globular or nearly so, rarely with any distinct neck, mostly cernuous and almost always striate. Peristome none or simple, or, most commonly, double, outer teeth 16, transversely trabeculate; inner shorter, processes cleft into two divisions, cilia imperfect or none. Male inflorescence usually discoid.

A very natural group of mosses, having (with the exception of a few exotic species) an almost uniform type of capsule, which when young is bright glaucous green, and smooth, but on ripening becomes brown and usually deeply sulcate. There is also a remarkable uniformity about the areolation throughout the Order; the papillose, short narrow cells of most of the species being very characteristic.

The papillae in this Order are mostly found, when present, not in the middle of the face of the cell, as is usually the case, but at either the upper or lower end, or both. They may, however, occur in the usual position.

68. CATOSCOPIUM Brid.

Slender, densely caespitose. Leaves narrow, *lanceolate-subulate*, areolation *small, rectangular, smooth*. Seta slender, capsule *minute, sub-globose, hard, blackish, shining, smooth,*

cernuous. Peristome *single*, of 16 *short obtuse* teeth; rudiments of an inner peristome sometimes visible.

The affinities of this genus are doubtful. In fruit it very much resembles Discelium, but the areolation is very different, and is certainly more like the typical areolation of this Order, though without the usual papillae. The following species is the only one of the genus.

DERIV.—κατω (katō) down, and σκοπεο (scŏpeo) to look; alluding the the cernuous capsule.

1. Catoscopium nigritum Brid. (*Weisia nigrita* Hedw.) (Tab. XXXVIII. D.).

Densely tufted, bright or brownish green; stems *very slender*, straight, not much branched, 2–6 inches high, radiculose below. Leaves small, slightly crisped when dry, *lanceolate, gradually tapering to an almost subulate point*, margin narrowly recurved to above middle, *entire;* nerve gradually *vanishing in the point*, prominent at back. Areolation *small, nearly uniform, narrowly rectangular*, at base about 3–6 times as long as broad, above rather shorter and slightly irregular, those of the marginal row shorter, sub-quadrate; all slightly incrassate, *smooth*. Seta *very slender*, rigid, $\frac{1}{2}$-$\frac{3}{4}$-inch long; capsule *minute, sub-globose, smooth, glossy*, at first reddish brown, finally purplish black, hard, *horizontally cernuous;* calyptra narrow, cucullate; lid conical. Dioicous.

HAB. Damp places on mountains, or among sand on shores; rare. Fr. late summer.

This remarkable moss might easily, in the absence of fruit, be taken for one of the Dicranaceae; in habit it is not unlike Ceratodon, and the regular, rectangular cells are much like those of Dicranella or Ditrichum. The fruit, however, resembles that of no other British moss except *Discelium nudum;* and in spite of the above resemblances, the leaves unite a number of characters not to be found in any single British species of Dicranaceae, so that if attention be paid to the description, there need not be any real difficulty in identifying it.

69. CONOSTOMUM Swartz.

Densely caespitose, stems fastigiately branched. Leaves *imbricated in 5 rows, small;* areolation as in Bartramia. Capsule rounded, cernuous, striate. Peristome *simple;* teeth 16, *long, narrow, united at apex so as to form a cone over the mouth of the capsule*.

A small genus distinguished from Bartramia by the arrangement of the leaves and the conical formation of the peristome.

DERIV.—κωνο-(kōno) cone, and στομα (stoma) a mouth, from the form of the peristome.

1. Conostomum boreale Swartz (Tab. XXXVIII. E.).

Very compactly tufted, tomentose below, *bright glaucous green;* stems slender, *fragile*, fastigiately branched, ½–4 inches high. Leaves small, *less than 1 line long, densely imbricated in five rows, giving a pentagonal outline to the stems*, when dry closely appressed and sometimes slightly twisted in a spiral direction; lower widely ovate-lanceolate, upper gradually narrower and longer, not plicate, keeled; nerve stout, vanishing in the lower leaves, in the upper excurrent in a short rigid brown cuspidate point; margin plane or very narrowly recurved in the middle of the leaf, minutely denticulate with the projecting transverse cell-walls; cells rectangular with rounded angles, or elliptic-rhomboid above, at base rather more lax, rectangular; the marginal rather narrower than the median; the upper faintly papillose. Seta ½–1 inch high; capsule cernuous, variable in size, *widely oval, gibbous at back*, deeply sulcate; calyptra narrow, cucullate; lid rostellate; peristome teeth inserted below the orifice, deep red, linear-lanceolate. Dioicous.

HAB. Peaty ground on the summits of the higher mountains; Scotland, frequent; Helvellyn. Fr. late summer.

The dense tufts or cushions, slender rigid stems and small, closely imbricated leaves arranged in five rows, which usually give a distinctly angular outline to the stems, render this species easy of recognition even without the fruit, which is less regularly globose than in most species of the Order, and with a very distinct form of peristome.

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70. BARTRAMIA Hedw.

Stems often robust, branching dichotomous, *not whorled*. Leaves *long and narrow*, usually papillose; cells very small, rectangular. Capsule (in the European species) sub-globose, deeply striate; peristome rarely absent or simple, usually double, *inner rarely with cilia*. Synoicous, or autoicous with the male flower *gemmiform* in all the British species.

The British species, at least, of this genus are easily known by their much longer and narrower leaves than are found in the plants of the rest of the Order. There is little variation in the form of the capsule, and the specific characters are for the most part drawn from the vegetative organs.

DERIV.—After Bartram, an American botanist.

1 { Leaves smooth, recurved towards apex; plant slender.....*1. Oederi*
  { Leaves papillose, patent or spreading.....2

2 { Ls. with wide, white, sheathing base; cells long and narrow...*3. ithyphylla*
  { Ls. scarcely sheathing; cells scarcely elongate.....3

3 { Capsule erect, symmetric ; leaves erecto-patent.....*2. stricta*
  { Capsule oblique ; leaves spreading.....4

4 { Seta erect ; capsule exserted ; leaves often glaucous green....*4. pomiformis*
  { Seta curved, very short ; capsule more or less hidden among the long, linear, setaceous leaves.....*5. Halleriana*

1. Bartramia Oederi Swartz (*Bryum Oederi* Gunn.) (Tab. XXXVIII. F.).

Densely tufted, tomentose below, deep green, 2–4 inches high, *more slender than B. pomiformis*, branching dichotomous or sub-fastigiate. Stems angular, usually triangular in section. Leaves *shorter and less crowded* than in that species, *about 1½ lines long*, spreading and recurved, when dry somewhat rigidly twisted and divaricate, rather glossy ; linear-lanceolate from an *indistinct, not sheathing base, shortly pointed ;* margin widely revolute for most of its length, towards apex sharply serrate ; nerve narrow, reaching apex or shortly excurrent, denticulate at back above ; areolation *smooth*, or nearly so (very lowly papillose) upper minute, shortly rectangular and sub-quadrate, resembling that of *B. pomiformis*, but slightly larger and more angular, at base more elongated and pellucid, reddish brown at the insertion, a few at the angles more lax and quadrate. Capsule on a straight seta, about half-an-inch long, *smaller than in B. pomiformis* (*½ line in diameter*), sub-erect or slightly cernuous, a little elongated when dry and empty, finely striate. Lid small, conical. Peristome double. Synoicous.

Hab. Mountain rocks, usually those which are calcareous. Not common. Fr. early summer.

This species is readily distinguished by its nearly smooth leaves, shorter, and more shortly pointed than in most of the allied species, without a distinct leaf-base. The capsule, also, is smaller and less deeply striate, and the whole plant more slender.

The serratures of the leaf are usually in two rows, being on the apparent edge, where the margin is folded back, as well as on the actual margin.

Very fine vertical striae are discernible on the cuticle of the capsule, best seen on fresh specimens. They are I think due to the confluence of minute pits, arranged in longitudinal rows.

2. Bartramia stricta Brid. (Tab. XXXVIII. G.).

Densely tufted, *short, about 1 inch high*, glaucous green. Stems straight, *rigid*, tomentose below. Leaves *almost erect, when dry closely appressed, short* (*1½ lines*), *straight, rigid*, fragile, *quickly narrowing usually from the very base*, lanceolate-subulate, margin slightly recurved above the base, towards apex finely but acutely denticulate ; nerve strong, yellowish, excurrent in a cuspidate point ; areolation narrow and dense, *papillose ;* the upper shortly and very narrowly rectangular, at base larger,

pellucid, a few rows at margin wider, quadrate. Seta erect, slender, pale, faintly angular above; capsule *erect, symmetrical,* small, oval-globose, narrowly striate; lid convex; peristome *simple*. Synoicous.

HAB. On earth or rocks. Near Maresfield, Sussex (*Davies*); Radnor (*Binstead*). Fr. spring.

B. stricta is a southern species, only known in this country from the above localities, and probably extinct in the former. In its straight rigid leaves it is only approached by *B. ithyphylla*, which is quite distinct in its longer areolation, and in the well-marked sheathing leaf-base; in some respects, indeed, the present species more resembles in appearance a species of Campylopus than a Bartramia.

The base of the leaf in this species is of a rather unusual, almost triangular shape, owing to its rapid narrowing from the line of insertion.

3. Bartramia ithyphylla Brid. (Tab. XXXVIII. H.).

Densely tufted, 1–2 inches high, *silky*, bright glaucous green or yellowish; leaves crowded, *2–2½ lines long, divergent from an erect, sheathing, glossy, white, scariose base*, straight and rigid; when dry erect and straight, rarely slightly flexuose; limb very narrowly linear-subulate, *suddenly contracted* above the oblong base, which is wider at the shoulders than at the insertion; margin *plane*, sharply and closely denticulate above; nerve strong, *indistinct in the limb*, excurrent in a fine denticulate subula; basal cells hyaline, very long and narrow, 4–10 times as long as broad, linear; in the limb shorter, *3–6 times as long as broad, opaque and obscure, sharply papillose*. Capsule as in *B. pomiformis*, on a usually rather longer seta. Synoicous.

HAB. Clefts of mountain rocks, frequent. Fr. summer.

Superficially resembling *B. pomiformis*, this species is really very distinct, and may be distinguished from it in the field by the divergent leaves and suddenly widened leaf-bases, which by their white, shining surface and erect, sheathing position give a very distinct appearance to the stem. In the former plant the leaf-base, although somewhat white and shining, is very rarely so distinctly so as in the present species, nor is it ever so sheathing nor so clearly differentiated from the limb of the leaf. The more rigid position of the leaves when dry will also as a rule distinguish the present plant. In *B. pomiformis* they are generally more flexuose, often strongly curled.

The nerve is usually said to occupy the greater part of the width of the limb, but if the leaf be treated so as to render it more translucent, it will be seen that the nerve is really comparatively narrow and that the lamina continues wide until very near the apex. The areolation is quite distinct from that of *B. pomiformis*, or, indeed, of any of the species; that of *B. stricta*, which most resembles it, being smaller, shorter and more distinct.

4. Bartramia pomiformis Hedw. (*Bryum pomiforme* L.) (Tab. XXXIX. A.).

Loosely or densely tufted, *soft*, yellowish green or pale bright glaucous green, less often dark green, tomentose below, very

variable in height (1–3 inches) and other characters. Leaves *long (2–2½ lines), patent, somewhat flexuose*, usually stellately spreading when seen from above, generally crowded; when dry more erect, *somewhat crisped;* very narrowly linear-subulate from a *paler, hardly expanded and not or scarcely sheathing base;* margin narrowly recurved for nearly the whole length of the leaf, or slightly thickened above, sharply serrate for most of its length in two rows, both on the actual margin and at the folded edge; nerve rather narrow, excurrent in a spinulose-denticulate subula; cells above *papillose, short, elliptical or subquadrate-rounded*, at base elongated, linear, hyaline. Seta about ½ an inch long, erect; capsule much exserted, *cernuous*, about 1 line in diameter, deeply sulcate. Autoicous or synoicous; male flower just below, and hardly separated from the fertile flower.

Var. β. *crispa* B. & S. (*Bartramia crispa* Swartz). *Taller*, in looser tufts; leaves less crowded, *longer, more curled when dry*, the base more distinct, *the innovations of the year often overtopping the ripe fruit.*

Hab. Sandy banks and clefts of rocks, common. The var. β on shady rocks on mountains, less frequent. Fr. spring.

The commonest species, and very variable. In lowland habitats it is short, pale green, loosely tufted, with laxly set leaves; in rocky mountainous localities it becomes much more densely tufted, with dense leaves, and usually of a more dingy tint; in similar but more shady or moister situations it passes into the var. *crispa*, which in its extreme forms becomes almost indistinguishable, without fruit, from *B. Halleriana*. It is at once known from the last species by the short, less opaque areolation and the leaf-base not suddenly dilated and not sheathing; from *B. stricta* by the flexuose, spreading leaves, of different form, and from *B. Oederi* by the highly papillose areolation and longer leaves.

The margin of the leaves is almost always revolute, but occasionally quite plane. It is, perhaps, worth noting that in the species of Bartramia and Philonotis, and most noticeably in those with larger fruits, the capsule, if it becomes fully matured before being emptied of its spores, retains its globular shape and somewhat glossy surface; if, however, as often happens, it is gathered before they are quite mature, even though the peristome is fully formed and the lid ready to fall, the capsules shrink in drying and elongate considerably, becoming oval-oblong and curved, and of a duller surface. This is, perhaps, most noticeable in the next species, but in the present and the preceding it is also quite evident, and on the same tuft capsules may often be found in both states and yet apparently in the same stage of maturity. The fruit is very persistent, and old setae of several years' standing may frequently be found.

5. Bartramia Halleriana Hedw. (*B. norvegica* Lindb., Braithw. Br. M. Fl.) (Tab. XXXIX. B.).

Tall and robust, in large, soft tufts, 2–4 inches high or more, bright green above, brown and tomentose below. Leaves *rather distant, very long (2½–3 lines), from an erect sub-sheathing base divergent*, spreading and flexuose, often subsecund; when dry

more or less crisped in the upper part, but usually rigid and little altered towards base; resembling those of *B. pomiformis* but with a slightly wider leaf base, which is a little more rapidly narrowed into the limb; areolation, nerve and margin as in that species. Capsules often in pairs, *seta short, curved, secund, not or hardly exceeding the leaves in length;* capsule rather large; longer than that of *B. pomiformis* when becoming elongated as described under that species, and deeply furrowed. Inflorescence as in *B. pomiformis*.

HAB. Damp shady rocks, usually near water, in mountainous districts; not common. Fr. summer.

The most beautiful species of the genus, and quite distinct in its more distant, longer leaves, and the short arcuate setae. The stem continues growing above the flower, so that in a very short time the fruit becomes lateral; and as it is persistent, the capsules of several successive years may be found clothing the stem at regular intervals, all turned to one side and presenting a very neat and beautiful appearance.

The tall lax forms of *B. pomiformis* var. *crispa* so closely conform to the present species both in general appearance and in the form and structure of the leaves that it is sometimes quite impossible to distinguish them without fruit. I have, indeed, found the two growing closely intermixed, and with setae of very varying lengths; but I am strongly inclined to suspect here a hybrid between the two species. As a rule, however, the leaves of the present species are more loosely set on the stem, less glaucous in colour, more divergent from the stem just above their base even when dry, and in their upper part more ascending, those of *B. pomiformis* tending to a spreading direction, so that each stem, looked at from above, has a somewhat stellate appearance.

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71. **PHILONOTIS** Brid.

Plants variable in size, often tall, stems with fasciculate branches, *producing whorled innovations below the inflorescence;* densely radiculose below. Leaves *short;* in the dioicous species often of two forms, those on the stem of the male plant more distant, appressed, less acuminate; cells *usually papillose*. Capsule cernuous, smooth or striate. *Inner peristome with the cilia well developed*. Paludal mosses, for the most part.

A rather large and very natural genus, differing from Bartramia, as regards our species, in the short, oval or lanceolate leaves, the whorled branching, the discoid male flowers (in the dioicous species), and the cilia of the inner peristome. The dioicous species are widely distributed and very variable, and consequently present great difficulties to the systematist.

DERIV.—φιλο-(philo) loving, and νοτις (nŏtis) moisture; alluding to the habitat of most of the species.

1 { Plant minute; seta curved; peristome absent.....*1. Wilsoni*
  { Seta straight; peristome present.....2

2 { Stem under ½-inch ; autoicous ; male flower gemmiform.....*2. rigida*
Stem usually over one inch ; dioicous ; male flower discoid.....3

3 { Tufts loose, without tomentum ; ls. wide-ovate, lower obtuse, cucullate *3. var. adpressa*
Tufts usually matted with tomentum ; ls. acute or acuminate.....4

4 { Plants very small, leaves not secund, singly toothed at margin *5. capillaris*
Plants larger, leaves doubly toothed at margin, at least below.....5

5 { Leaf margin plane, leaves not plicate, secund.....*3*. caespitosa*
Leaves plicate, margin revolute, nerve strong.....6

6 { Ls. falcate, median and upper cells wide, perigonial bracts acute *4. calcarea*
Ls. not falcate, upper cells very narrow, perigonial bracts obtuse.....7

7 { Ls. spirally arranged ; nerve thick, with numerous high papillae at back *3*. seriata*
Ls. erecto-patent ; nerve almost smooth at back.....*3. fontana*

A. PHILONOTULA C.M.

Small, procumbent plants, irregularly branched ; leaves not dimorphous. Synoicous or autoicous. Male flower gemmiform.

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1. Philonotis Wilsoni Braithw. (*Bartramidula Wilsoni* B. & S., Schp. Syn.) (Tab. XXXIX. D.).

Very small, slender, about ¼-inch high, pale green, in small loose silky tufts. Stems procumbent at base, branched in whorls from below the flowers. Leaves *small, ovate-lanceolate or lanceolate-subulate*, more or less longly acuminate, denticulate above, with plane margins ; cells at base lax, rectangular, gradually narrowing above, at apex shortly linear, faintly papillose, nerve vanishing at apex, rarely slightly excurrent. *Seta arcuate*, often two or three from one perichaetium, *about 3 lines in length ; capsule cernuous or pendulous*, small, globose, very slightly tapering to the seta, *not striate*, thin and membranous in texture, slightly rugose when dry ; lid convex ; *peristome none*. *Synoicous*.

HAB. On the ground on mountains, very rare. Fr. autumn.

This very beautiful little moss has only been found in four localities, two in Ireland and one each in Scotland and Wales, and out of Britain in a single station in Fernando Po ; much of its beauty arises from a delicate pink tinge to the capsule, which is lost in herbarium specimens.

2. Philonotis rigida Brid. (Tab. XXXIX. C.).

In small *dense* tufts, brownish green. Stems short, with longer, *rigid*, stellate branches, *fragile*. Leaves more or less erect or erecto-patent, *straight and appressed when dry, crowded*,

small, straight, rigid, narrow, lanceolate-subulate ; margin plane or slightly reflexed, sharply denticulate, nerve *strong*, prominent at back, excurrent in a short, fine, cuspidate point ; cells small, narrowly rectangular, slightly papillose, rather wider at base. Seta *long for the size of the plant* ($\frac{1}{2}$-1 inch), flexuose ; capsule *large*, globose, *striate ;* lid convex, apiculate. *Autoicous ;* male flower near the fertile, gemmiform.

HAB. Sandy banks and rocks, in warm or sheltered situations, rare. Fr. early summer.

A southern species, chiefly found on the southern coasts of England and Ireland, but also recorded from a few localities further north, and even from the Orkneys. The fruit is large for the plant, and when present there is no difficulty in recognising it ; and even when barren, the rigidity of the whole plant, the very narrow, straight leaves, hardly altered in drying, and the small size of all the parts, easily distinguish it from the species of the succeeding section ; it is a larger plant than the preceding, with quite different fruit.

B. EU-PHILONOTIS.

Usually robust and erect ; stems usually straight and regularly branched. Dioicous. Male flower discoid, terminal.

[The European plants comprised under this Section are closely allied to one another, several of them are extremely variable, and intermediate forms in many cases exist. The difficulty of determining their true position is also enhanced by the frequent sterility of the plants, barren stems alone, or stems possessing only one kind of flower, being often found. I am strongly of opinion that a comparison of a complete series of the European plants would reveal so many slight gradations and such a constant presence of intermediate forms as to render it necessary to group them all round *P. fontana* within the limits of a single species. Boulay, indeed, in his Muscinées de la France, has suggested and in fact carried out this view, and Thériot (Muscinées.....de la Sarthe, 1899, and Supplement, 1901) has shown good grounds for considering that *P. fontana* is united by a series of intergrading forms on the one hand with *P. calcarea* and on the other with *P. capillaris* and the continental *P. marchica*. Valuable work has been done on the continent of late years on this genus, by Dismier, Loeske, and others ; the principal conclusions arrived at are that certain forms, notably the "*adpressa*" form and the lax-celled, delicate form, are not independent groups, but may be found as parallel derivatives of several species. I have therefore reduced *P. adpressa* to the rank of a variety. I do not think however the case is established with regard to *P. seriata*, which I have retained as a sub-species.]

3. Philonotis fontana Brid. (*Mnium fontanum* L.) (Tab. XXXIX. E.).

In its typical form growing in tall, wide tufts, loose above, but closely interwoven below with tomentum, *usually yellowish green*, but not unfrequently of a pale glaucous green. Plant slender, 1–6 inches high or more, occasionally forked, usually producing several branches below the flowers, stem fragile, red. Leaves *ovate-lanceolate*, more or less longly acuminate, *usually imbricated all round the stem, very little turned to one side, appressed when dry; generally with 1–2 more or less distinct plicae on each side of the nerve, margin usually distinctly reflexed* one side generally more strongly than the other, or one side only, denticulate *in two rows* with the papillae and the transverse walls of the cells. Nerve rather strong, smooth or only lightly papillose at back, usually more or less excurrent, especially in the upper leaves; cells rectangular, towards the base rather loosely so, gradually narrower above, *the median about 6 to 9 μ wide*, in the acumen narrowly linear-vermicular; all somewhat incrassate and more or less strongly papillose at one or both ends. Leaves of the male stems more distant, appressed to stem, smaller, less acutely acuminate, with a shorter nerve. Seta dark red, ½–1½ inches long; capsule large, brown, thick-walled, striate, when dry sulcate, often slightly elongate and ovate. Male flower large, bright reddish brown, the bracts spreading, almost horizontal, widely ovate-triangular from an erect base, *obtuse and usually rounded at apex, serrate, nerve broad, thin, becoming indistinct and vanishing below the summit.*

Var. *β. tomentella* (*P. tomentella* Mol.) (Tab. XXXIX. F.). Tufts *compact, densely tomentose*; stems very slender, leaves small, *narrow, lanceolate, narrowly and finely acuminate*, hardly plicate, nerve usually longly excurrent.

Var. *γ. falcata* Brid. Leaves *falcate-secund, branches hooked at apex.*

Var. *δ. adpressa* (Ferg.) Loeske & Moenk. (*P. adpressa* Ferg., Handb. Ed. 2, (*P. heterophylla* Stirt. in Ann. Scot. Nat. Hist. xvii. 173) (Tab. XXXIX. H.). **Stems very slender and elongated,** 2–5 inches long, reddish below, *easily separating*, not or hardly radiculose, *weak and flexuose*. Leaves not crowded, *appressed, flaccid, very widely ovate from a broad, amplexicaul, slightly decurrent base*, with one or two plicae on each side, concave, *the lower obtuse and cucullate, the upper gradually more pointed, but rarely much acuminate*; nerve *very strong*, highly carinate, ceasing below apex or excurrent in the apical leaves; margin more or less reflexed areolation *very lax*, papillose. Stems of male plants scarcely differing from the rest.

Var. *ε. ampliretis* Dixon, Journ. of Bot. 1902, p. 71 (*P. laxa* Limpr.). Stems *exceedingly slender*, filiform, weak, scarcely

branched; leaves *distant, widely spreading*, not plicate, plane at margin; nerve *narrow*, scarcely excurrent; all cells *lax, thin-walled*, chlorophyllose, about 10 μ wide in upper part of leaf, very large and wide below.

HAB. Peat bogs and springs. Common in mountainous districts. The var. β at higher altitudes, usually by streams or among rocks. The var. γ, Wales, Scotland. The var. δ in springs and moist places on high mountains, usually sterile. The var. ϵ in springs and wet places, rare and sterile. Fr. summer.

The forms of this protean plant are endless, and no good purpose seems served by giving varietal names to the numberless variations which occur. The var. *tomentella*, however, (var. *compacta* Schp., p. p., Handb. Ed. 2) includes within narrow limits a series of forms of very similar habit, remarkable for their slenderness, compactness, densely tomentose stems, and uniform, narrow leaves, very finely acuminate, and with the nerve frequently longly excurrent (though occasionally vanishing),—the exact antithesis, in fact, of the var. *adpressa*. The var. *falcata*, as described by Braithwaite, is evidently an intermediate form between the present species and *P. calcarea*. The falcate direction of the leaves is however in itself neither important nor uncommon, and it is quite clear that different authors by no means intend the same plants by this name (*cf.* description of *P. seriata*).

A distinct tendency will usually be found in the upper leaves of var. *adpressa* towards the normal, acuminate form of *P. fontana*, with excurrent nerve; and it may be questioned whether, at the most, var. *adpressa* shows any wider variation from the typical form than does, in exactly the opposite direction, var. *tomentella*. It is in fact rather a form produced by local conditions (extreme altitudes and much moisture among them), as is evidenced by the parallel forms that occur in *P. caespitosa* and *P. seriata*. The wide, distant, erect and appressed leaves, not spreading nor falcate, very shortly pointed or even obtuse and cucullate, the slender stems only slightly radiculose and not coherent, render it, however, easy of recognition.

The arrangement and direction of the leaves resembles very nearly that of the special leaves on the male stems of *P. fontana*.

I gathered var. *adpressa* in fruit and with perigonia on Ben Voirlich (L. Earn) in 1897, and have since found the male plant in one or two other Scotch localities.

P. fontana frequently grows among rocks in and by mountain streams, and usually then departs widely from the typical form, very often in the direction of greater slenderness, with longer more undivided stems, usually barren, and with the leaves mostly shorter and smaller, the colour as a rule darker and more lurid, not uncommonly almost black. Very slender forms may be found approaching *P. capillaris*, while robust plants are not unfrequently seen which in the barren state are very difficult to separate from *P. calcarea*.

I have omitted var. *pumila* (Turn.), which appears to be a weakly marked and indeed rather doubtful variety.

The var. *ampliretis* is a very extraordinary plant, and is perhaps, only a very extreme aquatic state. Parallel forms occur in *P. caespitosa*, etc.

*** Philonotis caespitosa** Wils. (Tab. XXXIX. G.).

Shorter, *more slender*, soft or rigid, stems often curved at the tips, less branched. Leaves less closely imbricated, *homomallous*, small, shortly pointed, *not plicate, margin plane;* fruit

as in *P. fontana*. Male plants with small, appressed, less acuminate leaves; perigonial bracts wide, short, usually acute, with nerve distinct, reaching apex.

Var. β. *adpressa* Dism. Stems loose, scarcely radiculose; leaves often *appressed*, *widely oval*, *very shortly* acuminate.

Hab. Bogs and wet heaths, rare, and not found in fruit in Britain. The var. β rare; Wilts. (*Hurst*). Fr. summer.

The characters drawn from the leaves (secund, with plane or almost plane margins, and not plicate) seem to have more weight than the form of the perigonial bracts; though neither organ is free from variation, and transitional forms to *P. fontana* undoubtedly occur.

The male flowers are rare. In *P. capillaris* and *P. calcarea* the bracts are considerably longer than broad, and more narrowly acuminate than in the present plant, where they are almost as wide as long, so that their outline is nearly that of an equilateral triangle. In degree of acuteness however they vary very greatly, even in the same tuft, and I have occasionally seen some flowers with the inner bracts quite obtuse, and others sharply acute and even acuminate in the same gathering. Moreover, certain small forms of *P. fontana*, differing in other characters from *P. caespitosa*, have the bracts somewhat acute. Thériot considers that it forms the connecting link by which *P. fontana* passes, by two distinct chains of forms, into *P. calcarea* on the one hand, and through *P. capillaris* into *P. marchica* on the other.

The homomallous leaves may generally be looked upon as a reliable character.

The var. *adpressa* is an exact parallel to that of *P. fontana* (*P. adpressa* Ferg.).

*** Philonotis seriata** Mitt. (Tab. XXXIX. I.).

Resembling *P. fontana* but more robust, reddish below, tomentose. Leaves (especially where crowded) *spirally imbricated both wet and dry*, *rather long*, *falcate*, often widely pointed, plicate; nerve *very strong*, red, *strongly papillose at back*, not much excurrent; fruit and male inflorescence as in *P. fontana*.

Hab. On high mountains, Scotland, rare; fruit not found in Britain. Fr. summer.

The stout red papillose nerve and peculiar arrangement of the leaves, forming in the more typical specimens distinct spiral ridges on the stems both in the wet and dry state, are the most obvious characteristics of this plant, and give it a marked appearance under the lens. The seriate arrangement is however less visible where the leaves are more distant. Husnot considers *P. seriata* a form intermediate between *P. fontana* and its var. *falcata*. The latter variety has no doubt included, and was probably intended to include, forms which would now be termed *P. seriata*; but it would surely be more accurate to say that the forms with spirally twisted leaves and thick, papillose nerve, hitherto included under *P. fontana* var. *falcata* must now be separated and transferred to *P. seriata*, so long as the latter is held to deserve independent or sub-specific rank; the var. *falcata* being restricted to forms of *P. fontana* with falcate leaves, wanting the special characters above described.

I have gathered *P. seriata* in numerous localities, in Britain and on the continent, and have always found it well marked and very constant in its characters, very rarely showing any tendency to approach other forms, although sometimes mixed with them. It is in my opinion one of the best marked of the *P. fontana* group.

A form with appressed, shortly pointed leaves, occurs in this as well as in *P. fontana* and allied species, and has been given varietal rank by continental writers as var. *adpressa*.

4. Philonotis calcarea Schp. (Tab. XXXIX. J.).

Usually a *more robust* plant than the stoutest forms of *P. fontana*, of a *vivid bright or pale green*, rarely brownish or yellowish green. Leaves *larger*, longer, *more regularly falcato-secund*, with a *stouter nerve*, margin usually widely revolute only on one side, areolation *larger and wider*, about 10–15 μ at middle, less incrassate and more pellucid, papillose ; leaves of male plant less crowded, but otherwise little differing. Capsule *large*, resembling that of *P. fontana*. Perigonial bracts *acutely acuminate*, *much longer than broad*, *nerve well defined*, *reaching apex*.

Var. β. *mollis* Vent. *Very slender*, shorter, not tomentose ; leaves much more distant, *small, soft*, ovate-lanceolate ; nerve *narrower*, cells almost smooth.

HAB. Bogs and springs in calcareous districts ; not uncommon. The var. β rare. Fruit rare, summer.

In its typical and most common form, the colour and size of this species readily distinguish it from *P. fontana*, and the strong nerve and laxer areolation, rendering the leaf more pellucid, are also characteristic, as are also the length and direction of the leaves. I have, however, found plants with much more slender stems, and with the leaves in size and direction exactly as in *P. fontana*, the bright green colour and the nerve and areolation alone (besides the calcareous habitat) showing them to belong to this species ; and forms not unfrequently occur, principally alpine, which in size, colour and areolation are somewhat intermediate between the two species. The perigonial bracts, however, appear to be constant in their form and acuteness, and are probably to be relied on as a good specific character.

The var. *mollis* may be an undeveloped form only, but it is very different in appearance and structure from the type, bearing somewhat the same relation to it, though less widely removed, that the var. *ampliretis* does to *P. fontana*. The colour is usually pale, yellowish or whitish, by which, as well as by the somewhat falcate leaves, it may be known from slender, lax forms of that species.

5. Philonotis capillaris Lindb. (*P. fontana* var. *capillaris* Braithw., Br. M. Fl.) (Tab. XXXIX. K.).

Very small, $\frac{1}{8}$–*2 inches high*, *stems extremely slender*, *almost capillary*, often bright red, slightly branched, often procumbent ; tufts *bright or pale green ;* hardly radiculose. Leaves *very small*, *uniform*, slightly homomallous or erecto-patent, *narrowly ovate-lanceolate*, finely acuminate, *not concave nor plicate*, margin

plane or slightly and very narrowly recurved, marginal teeth *single, not in pairs*, nerve rather narrow, usually vanishing in apex; cells moderately lax, papillose. Perigonial bracts *spreading, squarrose or even slightly reflexed, rather long*, variously *acute; nerve thin*, rather indistinct, *usually vanishing below apex*. Capsule small, on a short seta.

HAB. In clefts of rocks and beside springs; rare. Fruit very rare, summer.

P. capillaris as here described, includes a number of forms characterised by the very slender, delicate habit, minute, uniform leaves, mostly with plane margins and free from plicae, with acute perigonial bracts. Numerous forms occur on the continent, several of which have been recently separated as species; Husnot has separated two forms, *P. capillaris* Lindb. with the perigonial bracts erecto patent, shortly pointed, with nerve reaching apex, and *P. Arnellii* Husn. with the perigonial bracts squarrose, even slightly reflexed, and much more longly and finely acuminate with the nerve excurrent; to these Philibert (*Rev. Bry.* 1894, p. 8) has added another, *P. Ryani*, somewhat intermediate in the perigonial bracts, but differing in the leaves; and later (*Rev. Bry.* 1897, p. 2) he still further subdivides the group, relying especially upon certain details of peristome structure. It seems, however, scarcely safe to rely upon characters drawn from a single gathering of a limited number of specimens, and in any case the fruit is so rare in the plants of this group that it can scarcely afford any practical help, and I am inclined to think that it is best to unite under *P. capillaris* all the forms which do not differ in any important characters either in the leaves or male bracts. As far as our own British specimens go, none appear to belong to any of the continental segregates named above, and although there is some difference in the direction and degree of acuteness of the male bracts among our different plants, it is no more than occurs for instance within the limits of *P. caespitosa*, while the leaf characters manifest a considerable degree of constancy. On the other hand I have seen plants scarcely distinguishable in size and vegetative characters from *P. capillaris*, with the obtuse inner bracts of *P. fontana*, and it is quite an open question whether *P. capillaris* has any more title to the rank of an independent species than, say, *P. seriata*. It must be remembered that the perigonial bracts are always erecto-patent for some time, and their direction must be determined from quite mature specimens. The above description refers to our British plants, so far as I am acquainted with them, alone. Owing to the facts referred to above, there has been, and is, great confusion as to the name *P. capillaris*, but I have thought it best to retain it here.

P. marchica, a continental species, is distinguished by the narrower male bracts, which are sub-erect, not spreading, and other characters. Some of our forms of *P. capillaris* nearly approach it, but the true *P. marchica* has not yet been detected in Britain.

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72. **BREUTELIA** Schp.

Tall, robust plants, with tomentose stems; branches irregular. Leaves *spreading and squarrose*, *plicate*; cells *narrow*. Capsule *more or less pendulous*, striate; peristome as in Bartramia.

A large genus of fine plants, the following species being the only European representative, and though not uncommon with us, a great rarity on the continent.

DERIV.—After Breutel, a German bryologist.

1. Breutelia arcuata Schp. (*Mnium arcuatum* Dicks. ; *Breutelia chrysocoma* Lindb., Braithw. Br. M. Fl. ; *Bartramia subvirella* Stirt. in Ann. Scot. Nat. Hist. xvi, 176) (Tab. XL. A.).

Tall, robust, 3–6 inches long, bright or golden green, in large loose tufts. Stems *covered with dense brown tomentum*, often decumbent, forked, or with alternate branches, or with somewhat whorled branchlets below the flowers. Leaves *large*, equal in size, from an erect base, *rigid, squarrose*, cuspidate at the tips of the branches, when dry somewhat shrinking, but *hardly altering in direction, glossy, sub-scariose ;* base somewhat sheathing, widening upwards from the insertion, then quickly narrowed and lanceolate, gradually tapering to a long, finely acuminate point ; *3–4 deep narrow plicae on each side of the nerve.* Margin plane or very narrowly recurved, finely and closely denticulate ; nerve *very narrow*, reaching apex ; cells very narrow, *linear*, 4–8 times as long as wide, gradually becoming longer below, a few at basal angles wider and larger ; upper usually with *a single sharp papilla* at the lower end. Perichaetial bracts erect, not papillose. Seta *short*, red, *arcuate*, usually abruptly bent, almost geniculate, about the middle ; capsule orange-brown, large, striate, sulcate when dry, thin-walled ; lid very small. Dioicous ; male flowers terminal, discoid, bright golden brown, the perigonial bracts finely acuminate.

HAB. Damp rocks, and in grassy spots, frequent by waterfalls and by mountain streams. Fruit very rare, autumn.

A very fine species, having some outward resemblance to some species of Hylocomium, such as *H. triquetrum* or *H. loreum*, in the branching and the direction and form of the leaves, a resemblance which is increased by the plicate, sub-scariose leaves with almost Hypnoid areolation. The colour, as well as the dense felt-like coating of brown tomentum that covers the stems for the greater part of their length is however quite sufficient to distinguish it at first sight ; and in the sharp papillae and narrow, single nerve the leaves are also quite distinct from those of the species named ; the large, plicate, squarrose leaves, and indeed the general habit, fully separate it from any of the other species of the present Order.

ORDER XVIII. BRYACEAE.

Plants usually tufted, the stems producing numerous innovations towards the base or below the inflorescence. Leaves usually increasing in size upwards and forming a comal tuft, the nerve long and frequently excurrent, the tissue usually thin and much shrunken when dry, with cells more or less rhomboid (less often hexagonal or linear-vermicular), prosenchymatous, smooth, thin-walled. Calyptra narrow, cucullate, smooth, soon falling off.

Capsule on an elongated seta, pendulous, or more or less inclined or sub-erect, never or very rarely erect ; symmetrical or nearly so, varying from rounded-pyriform to narrowly clavate, usually with a shorter or longer, tapering, narrow neck, not striate ; lid convex, mamillate or apiculate, rarely with a longer point (never rostrate in the British species except in Mnium). Peristome usually double ; outer teeth lanceolate, undivided, densely articulate and internally transversely trabeculate ; inner peristome thin, pale, usually of 16 more or less perforated processes alternating with the teeth, with or without intermediate cilia varying in development and number, often nodose with short transverse appendages at intervals (*cf.* Tab. LXIII.).

The typical "Bryoid" peristome will be found more fully described under Bryum.

A very large family, for the most part presenting a considerable uniformity of habit, and for this reason forming a natural group, but a difficult one for the systematist, and equally so for the student.

The descriptions of the size and form of capsule include the neck, unless otherwise stated.

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73. **OREAS** Brid.

Plants *densely tufted, stems slender.* Capsule erect or inclined, obovate-clavate with the distinct tapering neck ; peristome single or double, or absent. Inflorescence *gemmiform, lateral. Alpine rock plants.*

The species described below forms, with its varieties, the only European representative of the genus ; some of the varieties have been separated as species, and another species, *Oreas Martiana,* has been included, but turns out to belong to the Dicranaceae.

DERIV.—*ὄρεας* (oreas), belonging to mountains.

1. Oreas Mielichhoferi Brid. (*Mielichhoferia nitida* Hornsch., Schp. Syn.) (Tab. XL. B.).

Short, *very densely and compactly tufted,* deep silky green above, dark brown below, 2–3 inches high ; stems *very slender, rigid,* fastigiately branched. Leaves *small, short,* erecto-patent, rather rigid, *closely imbricated when dry,* oblong-lanceolate or narrowly lanceolate, shortly pointed, margin plane, denticulate towards apex, nerve rather stout, disappearing below the point ; cells narrowly linear-rhomboid, wider and rectangular at base, a few at basal angles quadrate. Seta rather short, flexuose ; capsule

obovate or clavate, with a distinct neck, erect or more usually inclined, pale brown ; lid conical, obtuse or apiculate ; peristome *single*, of 16 *narrow, linear teeth*, widening and slightly confluent at base ; pale yellow. *Dioicous ;* male inflorescence gemmiform, *lateral* on the stem or branches.

Var. *β. elongata* B. & S. (*Miclichhoferia elongata* Hornsch. ; *O. Mielichhoferi* var. *compacta* Braithw., Br. M. Fl. ; vars. *gracilis* and *elongata*, Schp. Syn.). Short or tall ; stems *extremely slender*, with smaller, *shorter, more closely imbricated leaves*. Nerve narrower, cells laxer, more pellucid, all basal cells rectangular.

HAB. The type not found in Britain. The var. *elongata* on wet alpine rocks, very rare ; usually barren. Fr. autumn.

This little moss is known by its very slender, compact stems, forming bright, velvety-green tufts, the leaves very small, but quite Bryoid in their structure.

The opinion seems to be growing on the continent that the two plants here described as type and variety are in reality specifically distinct. In any case, the varietal name *elongata* is misleading, as it describes neither a constant feature nor the most important distinguishing character.

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74. **ORTHODONTIUM** Schwaeg.

Small, *delicate mosses*, with *narrow, flexuose* leaves. Capsule small, *erect or inclined*, on a very slender seta, *narrowly oblong* with a slender, tapering neck. Peristome double ; outer teeth *narrow, distant ;* inner peristome a *very short* basal membrane with 16 processes, without intermediate cilia.

DERIV.—*ὀρθο*-(ortho) upright, and *ὀδοντ*-(odont) tooth ; alluding to the peristome.

1. Orthodontium gracile Schwaeg. (*Bryum gracile* Wils. ; *Stableria gracilis* Lindb., Braithw. Br. M. Fl.) (Tab. XL. D.).

Stems densely tufted, *slender*, hardly branched, about ¼–½ inch high, rarely taller, bright green, *silky*. Leaves *flexuose*, when dry somewhat curled, *very narrow, linear-setaceous*, the upper longest (1–1½ lines) ; margin plane, *entire or obsoletely denticulate above*, nerve vanishing at apex, *narrow*, rather indistinct above, areolation *narrowly linear-rhomboid*, at base wider, hexagonal-rectangular, hyaline. Seta short, *less than ½ inch high, pale, very slender ;* capsule *sub-erect, narrowly clavate*, with a slender tapering neck, thin-walled ; lid acutely pointed. Peristome teeth incurved when dry, inserted below the mouth of the capsule. Processes smooth. Paroicous ; antheridia in the axils of the comal leaves.

Var. β. *heterocarpa* Wats. (in Journ. of Bot. 1922, p. 140) Capsule *shorter, broader, often somewhat gibbous, and irregular;* frequently striate. Processes minutely papillose. Inflorescence *heteroicous*,—paroicous or with terminal or lateral male flowers.

Hab. Rock faces; and peaty soil at foot of trees; more rarely on rotten tree stumps; rare. The var. β about Crowden, Cheshire and Yorkshire; often on peat.

A very rare and distinct species, hardly known outside Britain except in two or three French localities, and several recently discovered stations in California. In habit it rather resembles the Dicranaceae than a Bryum, and may easily be taken for one of these or for *Campylostelium saxicola* without a reference to the microscope, when however, the areolation reveals its affinities; the leaves also are much longer. It resembles Leptobryum in the leaves, but the areolation is wider and looser, and the fruit much narrower and indeed altogether different.

The var. *heterocarpa* has a decidedly broader often pyriform capsule, which varies much in form, and in degree of striation, sometimes being nearly smooth. It is correlated with some vegetative characters, the leaves being usually shorter, with broader points, but they are not constant, and indeed all the characters noted are variable and indicate a certain amount of instability. The variety however is distributed over some considerable area in the district. Recent investigations indicate that it may prove to be a distinct species.

75. LEPTOBRYUM Wils.

Mosses with *annual* stems, not innovating above, *slender*. Leaves *very narrow, setaceous*, with *narrow* areolation. Capsule *pyriform, pendulous, glossy*. Peristome as in Bryum.

The habit, and the narrow leaves with broad nerve, seem to justify the separation of the few species of this genus from Bryum, which they resemble in the fruit.

Deriv.—λεπτο-(lepto) slender, and Bryum.

1. Leptobryum pyriforme Wils. (*Mnium pyriforme* L.) (Tab. XL. C.).

Closely tufted, pale shining green, *silky;* stems ½–1 inch high, very slender. Leaves erecto-patent or divergent, flexuose when dry, the upper longer, in a comal tuft, *linear-setaceous, long*, tapering to a subulate point, flexuose; margin plane, *denticulate above;* nerve strong, but rather indistinct, *broad, occupying most of the acumen*, slightly excurrent, cells *very narrow, linear*, pointed at the ends and prosenchymatous, or obtuse and parenchymatous, very long; seta *tall*, slender, rather flexuose, orange, *1–2 inches high;* capsule inclined or pendulous, pyriform with the long narrow neck, the capsule itself *oval-globose, abruptly passing into the neck*, thin-walled, *very glossy*, bright reddish brown,

rather wide-mouthed after the fall of the hemispherical, pointed lid. Peristome yellow, inner with long, appendiculate cilia. Spores 14–20 μ. *Synoicous*, or imperfectly dioicous.

Var. β. *minus* Husn. (*L. minus* Philib.). Generally *smaller* in all its parts; *leaves, seta, and capsule short*, peristome pale, *small*, the cilia imperfect, *without appendages*. Spores *larger*, 16–24 μ.

HAB. Sandstone rocks, cinders, etc., often in hothouses, not uncommon. The var. β, Coatham Marshes, Yorkshire, 1900 (*Ingham*). Fr. spring or early summer.

A very elegant and beautiful plant, both in the leaf and in the fruit, which, when present, is usually very abundant; the setaceous leaves give it the appearance of a Dicranella or Dicranodontium. Barren plants with terminal flowers often occur, having the appearance of male plants, but they contain abortive archegonia mixed with the antheridia. Small purplish bulbiform gemmae are sometimes produced on the stems or protonema.

Leptobryum differs from *Orthodontium gracile* in the more denticulate leaves with broader nerve and narrower areolation, as well as in the fruit. The burnished capsules are exceedingly pretty.

The var. β appears to me a starved form of the type, and I should not have admitted it as a variety were it not for the somewhat larger spores, a character of some value.

76. WEBERA Hedw.

(Pohlia *Hedw.*, Braithw. Br. M. Fl.).

Tufted, stems usually slender, *rarely innovating above*. Leaves usually rather narrow, *becoming narrower in the upper part of the stem*, and often much longer in the coma, *nerve rarely excurrent*, cells *narrowly rhomboid or almost linear*, rarely wider. Calyptra small, very soon deciduous. Capsule pyriform to clavate, with or without a tapering neck. Peristome as in Bryum; but cilia *without appendages*.

This genus differs from Bryum chiefly in the habit and in the usually narrower areolation; still, there is a character about the plants belonging to it by which they may be generally known at once, produced by the narrower leaves, the stems usually more slender, less frequently innovating below the inflorescence and consequently not as a rule producing the densely crowded tufts so usual in Bryum. The nerve, too, always (in our own species) ceases below the point or, at any rate, fails to reach beyond it, whereas in Bryum it is most frequently more or less excurrent. The fruit generally shows a more marked differentiation between the capsule and neck than is usual in the latter genus.

DERIV.—After Weber, a botanist of Gottingen.

1 { Ls. wide-ovate, entire, with reddish border of narrow cells...*10. Tozeri*
  { Ls. not evidently bordered....2

2 { Ls. very decurrent, the lower obtuse ; tufts red within.....*6. Ludwigii*
  { Ls. not or scarcely decurrent, usually acute or acuminate....3

3 { Cells wide, over 15 μ ; capsule very short and small....4
  { Cells narrow, under 15 μ ; capsule longer or larger....5

4 { Plant soft, 1-3 inches ; leaves glaucous-green....*9. albicans*
  { Plant rigid, $\frac{1}{2}$-1 inch ; leaves not glaucous....*8. carnea*

5 { Capsule long and narrow, with long neck....6
  { Capsule oblong or pyriform, neck short....8

6 { Neck very long, longer than capsule ; peristome with cilia...*2. elongata*
  { Neck shorter than capsule ; cilia absent or rudimentary....7

7 { Male flower gemmiform ; lid of capsule usually acuminate...*1*. acuminata*
  { Antheridia naked in axils of comal ls. ; lid usually muticous *1. polymorpha*

8 { Upper ls. very long, shining, reddish at base....*3. cruda*
  { Leaves shorter, not red (except the nerve)....9

9 { Paroicous, antheridia in the axils of upper leaves....10
  { Dioicous....11

10 { Ls. acute, serrate above ; capsule usually contracted below mouth *4. nutans*
   { Ls. sub-acute, often cucullate, sub-entire ; capsule small at mouth *4*. cucullata*

11 { Upper ls. nerved to apex, usually with axillary gemmae....12
   { Leaves not nerved to apex....13

12 { Gemmae few, or very small and egg-shaped....*5. annotina*
   { Gemmae very numerous, long and fusiform....*5*. prolifera*

13 { Leaves widely ovate, incurved when dry....*7. commutata*
   { Leaves narrow, straight and appressed when dry....*7*. gracilis*

A. POHLIA.

Slender ; leaves suddenly elongate and narrow in the comal tuft, with narrow, linear-rhomboid cells ; not bordered, nor distinctly dimorphous. Capsule inclined or horizontal, long-necked, oblong. Inner peristome with a narrow membrane, cilia absent or rudimentary ; processes entire or only slightly perforated.

1. Webera polymorpha Schp. (*Pohlia polymorpha* Hornsch., Braithw. Br. M. Fl.) (Tab. XL. E.).

Variable in habit and in size of its parts. Slender, loosely tufted, usually about half-an-inch high ; stems almost simple, with a few innovations from the base, rarely from below the flowers. Lower leaves *small, ovate-lanceolate*, increasing in size upwards, the uppermost crowded, *much longer, lanceolate*, forming a comal tuft ; the leaves on the barren innovations

usually sub-equal. Margin *recurved below*, plane above, more or less denticulate in the upper half, more strongly at the apex; nerve usually reaching to apex, brownish; cells narrowly hexagonal-rhomboid, or linear-rhomboid, narrower at apex, wider and sub-rectangular at base. Seta very variable in length, 1¼–¼ inches long, slender, straight or curved; capsule very variable, *ovate-oblong with a tapering neck of varying length and distinctness, horizontal or slightly pendulous*, reddish brown, *1-1½ lines in length* with the neck; lid convex, apiculate or shortly and acutely acuminate. Peristome *reddish brown*, the inner paler, yellow, *cilia absent or very rudimentary*. *Paroicous;* antheridia in the axils of the upper leaves, in pairs.

Var. β. *brachycarpa* Schp. (*Pohlia brachycarpa* Hornsch.). *Shorter and more compact* in all its parts; stems short, leaves closer; seta stouter, short; capsule *shorter, thicker, less tapering*.

HAB. On earth and among rocks on mountains, not common. The var. *brachycarpa* more rare. Fr. autumn.

As its name implies, this is a most variable species; many varieties have been described, but for the most part they are forms rather than varieties in the strict sense. The capsule is almost always shorter, and, in proportion to its length, wider than in *W. elongata*, and is more inclined, often pendulous; the inner peristome also has the cilia usually quite wanting.

*** Webera acuminata** Schp. (*Pohlia acuminata* Hornsch., Braithw. Br. M. Fl.) (Tab. XL. G.).

The only constant difference between this plant and *W. polymorpha* is in the inflorescence, which in *W. acuminata is autoicous; the male flowers gemmiform*, below the fertile flower or on a short branch, with several small ovate bracts. The leaves are most frequently a little more rigid, the cells slightly longer, the lid of the capsule more acuminate, and the neck slightly more elongated and distinct, but these characters are by no means constantly present.

HAB. In similar situations, but more frequent. Fr. autumn.

There can be no doubt that the characters, beyond that derived from the inflorescence, which are sometimes given as separating *W. acuminata* and *W. polymorpha* are quite without value, both as to constancy and importance. This being the case, it is a manifest absurdity to found two species upon differences which in such a closely allied plant as *W. cruda* exist in as great or even greater degree without being made the basis of even varietal distinction.

W. acuminata varies in almost as great a degree as *W. polymorpha*, and on somewhat parallel lines; the stems are sometimes much elongated, reaching as much as three inches in height, but this is rarely the case. It is a more common moss than *W. polymorpha*, and plants with a distinct narrow neck and longly acuminate lid may be generally anticipated to be the present sub-species; but no diagnosis can be safe without examination of the inflorescence.

2. Webera elongata Schwaeg. (*Pohlia elongata* Hedw., Braithw. Br. M. Fl.) (Tab. XL. F.).

Plants resembling *W. polymorpha* in habit, loosely or densely tufted, bright pale green, ½–1 inch high. Comal leaves rather longer, lanceolate, nerve vanishing at or below apex, areolation narrow, linear-rhomboid, somewhat vermicular. Seta *long, slender, 1–2 inches high ;* capsule *sub-erect and inclined,* rarely horizontal or very slightly drooping, pale, usually very long and narrow, *clavate, 1½ 3½ lines long,* the neck *very long and thin, longer than the capsule itself.* Lid conical, acuminate. Outer peristome *yellow,* inner with a short basal membrane, reaching about ⅓ the height of the teeth, cilia two, short, not appendiculate. *Paroicous ;* antheridia in pairs in the axils of the upper leaves.

HAB. Grassy banks and clefts of rocks on mountains ; frequent. Fr. autumn.

W. elongata is a variable species, though not to the same extent as the previous plants ; and the capsules are sometimes difficult to distinguish from those of *W. acuminata.* This however, is rarely the case, and as a rule there is little difficulty in recognising the present species, the long, graceful seta, and the delicately poised capsule, longer necked, much elongated and slender, giving it a well marked aspect ; and the other characters italicised above have also some value. In my experience it is much more addicted to narrow crevices of rocks near streams than to the open, terrestrial habitats usually occupied by the preceding species.

The capsule is often described as slightly contracted below the mouth, but this, I am inclined to think, rarely if ever occurs except where the capsule has dried before properly ripening.

Plants collected by Mr. Young on Craig Chailleach, Perthshire, with the male flower terminal on a long innovation and with the peristome nearly that of *W. acuminata,* appear to belong to *W. ambigua* Limpr., described by Breidler, I think perhaps most satisfactorily, as "intermediate between *W. acuminata* and *W. elongata,*" and for the present best placed here.

B. EU-WEBERA.

Leaves wider, without a distinct border, not dimorphous, the comal less suddenly elongated, the areolation usually wider. Capsule wider, with a shorter neck ; basal membrane of the inner peristome usually higher, cilia present, often perfect, not appendiculate ; processes usually with a more or less gaping slit along their median line.

3. Webera cruda Schwaeg. (*Mnium crudum* L. ; *Pohlia cruda* Lindb., Braithw. Br. M. Fl.) (Tab. XL. H.).

Robust, 1–3 inches high, reddish brown below, *glaucous green and glossy* above, stems red, simple, densely tufted. Lower leaves *broadly ovate,* gradually becoming narrower and more

elongate upwards, the comal long, lanceolate, not very acute, of rigid texture, *hardly altered in drying*, often deep red at the base, pellucid ; margin plane, faintly denticulate at apex or entire in the lower leaves, more distinctly toothed in the upper ; nerve ceasing below apex ; cells linear, sub-vermicular, pointed and prosenchymatous at the ends, rather larger and rectangular at base. Seta long, flexuose ; capsule rather large, variable in form, *clavate-oblong or cylindrical*, frequently curved upwards or downwards, bright pale reddish brown, horizontal or slightly drooping, when dry often contracted at and for some distance below the mouth ; *neck rather short, thick*, indistinct ; lid conical, apiculate ; peristome pale yellow ; basal membrane of inner peristome hardly $\frac{1}{3}$ the height of the teeth ; cilia 2 or 3, well developed ; processes not widely gaping along the median slit. Autoicous, more rarely synoicous or dioicous.

HAB. Clefts of rocks on mountains ; not uncommon. Fr. late summer.

A very fine and beautiful species, known at once by the metallic, almost opalescent sheen on the leaves, which are larger and wider than in the allied species, and but little altered in drying. The red stems too are conspicuous, and the capsule of a distinct form, though subject to variation. It is perhaps most like *W. albicans*, but the texture of that plant is softer and quite different, the areolation much wider, and the capsule much shorter and broader.

4. Webera nutans Hedw. (*Bryum nutans* Schreb. ; *Pohlia nutans* Lindb., Braithw. Br. M. Fl.) (Tab. XL. I.).

Variable in size and habit ; loosely or densely tufted, *usually deep green*, pale brown below, shining, $\frac{1}{2}$–2 inches high. Lower leaves small, ovate and ovate-lanceolate, upper gradually much longer, the comal narrowly lanceolate with a long tapering acumen, not or rarely decurrent, when dry erect, *somewhat shrinking and flexuose ;* margin somewhat recurved below, denticulate above ; nerve strong, vanishing in or below apex ; areolation resembling that of the last but rather shorter and wider. Seta pale reddish, very variable in length ($\frac{1}{2}$–3 inches), capsule horizontal or sub-pendulous, variable in form and size, but always *wider and less tapering* than in the foregoing species, with a distinct but very short neck, dull brown, oblong or obovate, often somewhat gibbous on the under side, when dry frequently contracted below the *wide mouth ;* lid widely mamillate ; *annulus broad ;* peristome orange-yellow ; inner with a membrane about half the height of the teeth, cilia two, well developed ; processes widely gaping at the median slit. *Paroicous.* Antheridia in the axils of the upper leaves.

Var. *β. longiseta* B. & S. (*W. longiseta* Brid.). Stems simple ; comal leaves *very long*, acuminate, spreading ; seta *very long ;* capsule *large*.

Var. *γ. bicolor* B. & S. (*Webera bicolor* Hoppe & Hornsch.). *More compact*, with numerous sterile branches, their leaves subequal, ovate; capsule *short, wide*, cernuous, *darker on the upper side*.

Hab. Peaty and sandy soil, in woods and in sub-alpine districts. Common. The var. *β* on damp heaths, not uncommon; the var. *γ* on mountains, rare. Fr. early summer.

The commonest species of the genus, and perhaps the most variable. The colour is usually a very deep green, the texture soft, the whole plant slender. In neither the fruit nor the vegetative characters is it likely to be taken for any of the foregoing species; in texture and habit it is entirely distinct from *W. cruda*, while the preceding species have narrower lower leaves, almost constantly narrower capsules with longer, narrower neck, smaller mouth, and very different inner peristome. The following plants, with the exception of *W. cucullata*, are all dioicous.

The areolation of the lower leaves is often much wider than that of the narrower upper ones, and in fresh plants is highly chlorophyllose. When growing, as it frequently does, at the foot of trees in woods, it often forms large dense patches, with numerous slender barren innovations: this is the var. *caespitosa* B. & S. In this state it fruits less freely than in the other forms.

A mountain or sub-alpine form which I have from very numerous localities, principally in the North of England and Scotland, bears a close resemblance to *W. cucullata* and *W. commutata*; the stems are closely tufted, barren in nearly all the specimens I have seen, with looser or denser shortly and widely oval leaves with very short points, frequently decurrent at base, with a stout nerve usually ceasing below the apex; cells wide and short, as in *W. commutata*; the tufts are often but not always somewhat glossy, the leaves often catenulate when dry. Altogether it forms a very distinct variety, which I cannot refer to any of the named European forms known to me, but I hesitate at present to describe it as new. A plant gathered by Lindberg in Ireland in 1893, and labelled by him "var. elata et compacta," may perhaps be the same thing.

***Webera cucullata** Schp. (*Bryum cucullatum* Schwaeg.; *Pohlia cucullata* Bruch, Braithw. Br. M. Fl.) (Tab. XLI. A.).

Differs from *W. nutans* in the leaves usually, but not always *less glossy*, rather shorter, *less pointed, often rather obtuse with the apex cucullate: less strongly denticulate*; capsule *more exactly pendulous*, contracted at but not below the *narrow mouth*; lid small, conical, obtusely pointed; peristome teeth *narrower and less* crowded; cilia of inner peristome *very short*, fugacious.

Hab. On earth and among rocks in mountains; very rare. Scotland. Fr. late summer.

The above characters are, as will be seen, hardly of first importance, and their value is greatly diminished by the fact that many of them, to say the least, are inconstant. Some specimens are fully as glossy as *W. nutans*, which is itself very variable in this respect, while in that species the leaves are very variable in size, and occasionally are cucullate, besides showing much variation in the amount of denticulation. The capsule in the present plant is occasionally, if not frequently, somewhat horizontal instead of

actually pendulous, while the narrow mouth, though a more constant feature, is not absolutely so. In all the capsules I have examined, the peristome teeth are narrower and more distant than in *W. nutans*, but this does not seem to have been generally noticed, and is therefore probably inconstant; possibly, like the rudimentary character of the cilia, it is a condition of depauperation owing to the alpine situation. On the whole, therefore, it appears more satisfactory to subordinate the plant to *W. nutans*.

The plant recorded in Ed. I. from Derbyshire, of which I had not at that time seen specimens, certainly belongs to the short-leaved, wide-celled variety of *W. nutans* referred to in the note above.

The areolation of the lower leaves is lax, but this is often the case in *W. nutans*; in the comal leaves there is little difference between the two plants, though on the whole the cells are a little narrower and firmer in the latter.

5. Webera annotina Schwaeg. (*Mnium annotinum* L.; *Pohlia annotina* Lindb., Braithw. Br. M. Fl.) (Tab. XLI. B.).

Loosely tufted, pale or yellowish green, with *straight, slender, rather rigid innovations*. Leaves small, often decurrent, the lower ovate-lanceolate or lanceolate, upper longer and narrower, erect or imbricated when dry; margin slightly recurved, denticulate above; nerve reaching usually to apex; cells rather small, narrowly rhomboid, not very chlorophyllose, the walls firm. Barren stems usually bearing very small, green, *scarcely stalked, ovate* bulbils, *several together* in the axils of the leaves *throughout the greater part of the stem*. Seta red, flexuose; capsule bright reddish brown, *widely oval with a tapering neck of about the same length;* mouth small; lid conical, apiculate; *annulus broad;* peristome bright yellowish; inner with the processes widely gaping, and cilia in pairs, long, rough. Cells of exothecium somewhat *collenchymatous*. *Dioicous;* male inflorescence terminal, gemmiform.

Var. β. *erecta* Correns (*Trentepohlia erecta* Roth). Leaves a little more crowded, sub-erect; bulbils *large*, ovate, brown when ripe, *single in the axils of only a few of the middle or upper leaves*, which are rendered divergent by the size of the bulbils.

Var. γ. *bulbifera* Correns (*W. bulbifera* Warnst., *W. annotina* var. *tenuifolia* Schp., Handb. Ed. I.). Bulbils *in number and position as in the type*, but differing in structure; somewhat distinctly *stalked*, ovate, *the upper half being an empty hollow space*, arched over by the rudimentary leaf points.

HAB. Sandy places and sandstone rocks; not common. Fruit rare, summer.

This species is very variable, and presents considerable difficulty to the student. The fruit is rare, and the gemmae, by which the plant may generally be known, are not always present, and when occurring exhibit a considerable variety of forms; there is, moreover, nothing very distinctive in the leaves, though they are usually more delicate and less chlorophyllose than in *W. nutans* and *W. cucullata*.

The straight, rigid sterile branches with uniform foliation, and the dioicous inflorescence, are characters of importance. The distinction often drawn between the various allied plants of this group according to the glossiness or otherwise of the leaves I have found quite fallacious. *W. commutata* is exceedingly like forms of *W. annotina*, and in the absence of fruit very hard to separate; it usually has more rigid, somewhat less crowded leaves, more constantly glossy; when in fruit the longer neck and collenchymatous cells of the present plant distinguish it.

The varieties described above seem of more value than those depending on the form and structure of the leaves alone, but I am somewhat inclined to doubt their stability. Other distinguishing characters have been described as to leaf-form, habitat, etc., but they do not appear to be constantly correlated with the form of the bulbils.

Nor do the bulbil characters afford an absolutely clear-marked test. Mr. Hurst, for instance, sends me from Wiltshire a series of forms showing some stems with *"annotina"* bulbils, others with large single bulbils hardly distinguishable from the *"erecta"* form, and a few with both forms of bulbil on the same stem.

*** Webera proligera** Bryhn (*Pohlia proligera* Lindb.) (Tab. XLI. C.).

Slender, bright *pale green*, in lax tufts or gregarious; leaves rather longer and larger than in *W. annotina*. Bulbils *very numerous* in the axils of all the leaves in the upper half of the stem; *long and narrow, fusiform*, with longer, narrower, somewhat twisted points. Neck of capsule slightly shorter, cells of exothecium *not* collenchymatous.

HAB. Sandy ground and sandstone rocks, not rare. Fruit very rare, summer.

A very distinct plant in the form of the gemmae, which are like no others of our species, more resembling, indeed, those of *Plagiothecium elegans*. Their form has been somewhat aptly compared to that of an empty glove. The difference in the exothecium cells appears also to entitle it to a somewhat higher position than the above described varieties of *W. annotina*, but the fruit has been so rarely gathered that this may possibly prove to be less constant than is supposed. Other characters I find unreliable: Limpricht describes the present plant as glossy and thus differing from *W. annotina*, which is said to be without gloss, but Mr. Nicholson gathered fruiting *W. proligera* in Cornwall, entirely without gloss, side by side with *W. annotina* (as shown by the bulbils), which was decidedly glossy. The form and disposition of the leaves I find to be equally variable. As a rule, however, it is a softer, weaker plant than *W. annotina*, of a brighter green and with less rigid leaves. I have gathered it two inches high in the Pyrenees.

Continental writers separate our plant (as *W. annotina* var. *decipiens* Loeske) from *proligera*, basing the distinction on certain leaf characters and a slight difference in the form of the gemmae. The latter character at least does not appear to me of great value, and on the whole it seems to me best to include all forms under *W. proligera*.

W. proligera is in part at least identical with *W. annotina* var. *angustifolia* Schp.

6. Webera Ludwigii Schp. (*Bryum Ludwigii* Spreng.; *Pohlia Ludwigii* Lindb., Braithw. Br. M. Fl.) (Tab. XLI. D.).

Rather robust, loosely or densely tufted, *soft*, deep or bright green above, *with a strong vinous red tinge below*, 1–2 inches high, stems red, decumbent or erect. Leaves on the barren shoots sub-equal, *widely oval, obtuse or obtusely pointed*, when dry *somewhat imbricated and not much altered, strongly decurrent*, margin narrowly recurved, obtusely denticulate at apex; nerve red in the older leaves, ceasing below the apex; areolation narrowly rhomboid-hexagonal, thin-walled, *much wider than in any of the preceding species*. Comal leaves of the fertile stems larger and more acute. Capsule sub-pendulous, pyriform with a short neck, *annulate;* peristome pale yellow, inner with 2–3 cilia between the processes. *Dioicous*. Male flower terminal, gemmiform.

Var. *β. latifolia* Schp. Tall, *robust, 3–5 inches high*, bright green above, bright reddish brown below. Leaves *large, widely ovate-cordate*, obtuse or pointed, *concave; cells larger*.

HAB. Springs and earth among rocks in high alpine localities, rare; usually sterile. The var. *β* in alpine streams and springs, very rare. Fruit very rare, late summer.

A very distinct species, easily known from nearly all of the genus by the ruddy interior of the tufts, the wide, generally obtuse leaves with lax areolation, and especially by the decurrent base of the leaves, forming wings for some distance down the stems. *W. commutata* differs in the absence of the vinous red colour, the leaves smaller and hardly decurrent, and the smaller size; *W. albicans* in the colour, the less decurrent leaves with plane margins and exannulate capsule, while all the preceding species differ in the narrower leaves and cells.

The var. *latifolia* is a very striking form, the leaves and habit reminding us of *Bryum turbinatum* var. *latifolium*. A study of a large number of forms has decided me in dropping the var. *elata* Schp. I am not aware that any original specimens exist (there are none in either Schimper's or Hunt's herbarium at Kew), and Schimper's description does not imply any marked deviation from the ordinary forms, which frequently attain a similar stature, 3-4 inches, without showing any difference in the leaf from the type, which, moreover, varies considerably in the amount of serration of the leaves and their acuteness, as well as their texture, without being correlated with the other characters of the var. *elata*.

An abnormal form of *W. Ludwigii* occurs with many of the leaves broadly rounded, circular in outline and cymbiform, as in *Bryum cyclophyllum*.

There is a specimen of var. *latifolia* Schp. in his herbarium at Kew (Salzburger Alpen, Funck), with which our British plant agrees very well.

W. Schimperi Wils. MS., *non W. Schimperi* (C.M.) Schp., (Ben Lawers, 1868; Snowdon, 1865, *Hunt*), is perhaps identical with the var. *elata*: at any rate, it agrees in its acute leaves and marked serration with the description of that variety, but I should not consider it more than a slender form of *W. Ludwigii*.

7. Webera commutata Schp. (*Pohlia commutata* Lindb., Braithw. Br. M. Fl.) (Tab. XLI. E.).

Closely allied to *W. Ludwigii*, but smaller and differing in the colour, *not reddish below*, but either pale brown or blackish,

dull pale green above or glossy ; *slender*, with elongated barren shoots, the leaves small, widely oval, *short and shortly pointed or sub-obtuse*, when dry *closely incurved and imbricated, giving a catenulate appearance to the stems ; not or very slightly decurrent ;* margin plane or very slightly recurved ; nerve *very strong and thick*, vanishing below apex ; cells wider (in proportion to their length) than in *W. nutans*. Capsule sub-pendulous, dark purplish red, oval-pyriform with a tapering neck, *shorter* than the sporangium ; lid conical, apiculate. Cells of exothecium *not collenchymatous*. Dioicous.

Var. β. *catenulata* Dixon (*Bryum catenulatum* Schp.). *More robust, rigid ;* leaves *larger*, when dry rigidly incurved and turned to one side, giving the stem a slightly spiral, strongly catenulate appearance.

Hab. Rocks on high mountains, rare. The var. β, Ben Lawers. Fr. late summer.

This is certainly distinct from *W. Ludwigii*, not only in the colour, which exhibits nothing of the vinous red tint of that species, but also in the leaves, which are usually smaller, not or hardly at all decurrent, rarely obtuse, or sub-obtuse, and in the nerve which is very stout, especially in the lower part of the leaf. It varies considerably ; an elongate, slender form with rather wider, more loosely areolated leaves being the *Bryum filum* of Schimper, Synopsis Ed. II. The var. *catenulata* has especially marked the rigid, chain-like appearance of stem which is characteristic of the species ; alpine forms of *W. nutans* and *W. cucullata* come very near it in appearance, and some sterile forms can scarcely be distinguished, though as a rule *W. commutata* is more glossy, and the leaves are more rigid and catenulate when dry. The plant most liable to be confused with it, however, is *W. annotina*, which differs somewhat in the fruiting characters as mentioned under that species ; but when sterile the two plants are very likely to be confounded. *W. commutata* has generally more glossy, more distant, wider, less flexuose leaves. Bulbils not infrequently occur in the axils of the leaves, resembling those of *W. annotina* var. *erecta*.

W. commutata fruits more frequently than *W. Ludwigii*. Sterile forms are however sometimes difficult to distinguish. I believe the cells in *W. commutata* are usually firmer, more rectangular (less hexagonal), and less markedly narrowed at margin.

* **Webera gracilis** De Not. (*Bryum gracile* Schleich. ; *Pohlia gracilis* Lindb., Braithw. Br. M. Fl.) (Tab. XLI. H.).

Differs from *W. commutata* in the *more rigid stems and barren innovations*, with *narrower* leaves which are *straight and appressed to the stem*, not incurved or catenulate when dry ; and in the capsule, which is *very short and small*, with a much shorter neck, ovate or turgidly oblong-pyriform.

Hab. Alpine rocks and sandy places ; very rare. Scotch mountains. Sands of Barrie (*Forbes*). Fr. late summer.

This has a different habit and different capsule from *W. commutata ;* but it is undoubtedly closely allied to it, and the characteristic growth and

habit may be occasionally seen in that species; I have thought it, therefore, more satisfactory to consider it a sub-species of *W. commutata*. The seta is frequently very strongly twisted or looped at the summit when dry, so as to bring the capsule from a pendulous into a horizontal position.

8. Webera carnea Schp. (*Bryum carneum* L.; *Pohlia carnea* Lindb., Braithw. Br. M. Fl.) (Tab. XLI. F.).

Plants loosely or more densely tufted, in wide patches, *very pale green*, becoming reddish when old, *rarely one inch in height*. Stems red, with numerous fastigiate slender innovations bearing sub-equal leaves. Stem-leaves becoming somewhat larger upwards, *small*, narrowly lanceolate, the comal elongate-lanceolate; when dry erect or erecto-patent, not incurved nor appressed, slightly flexuose, denticulate in the upper half, margin plane or almost so, nerve ceasing below apex, reddish at base; cells *widely rhomboid-hexagonal* (*18-25 μ wide*), at base looser, but hardly rectangular; the marginal in two or three rows somewhat distinctly narrower. Seta *short* (about ½-inch), *rather thick and succulent when young*, finally deep red below, paler above, flexuose, often strongly hooked at summit, rendering the capsule pendulous; capsule *very small*, with the neck very shortly oval-pyriform, when dry and empty *wide-mouthed, exactly and widely pyriform*, the capsule itself oval-globose, with a short but narrow and distinct neck; before maturity of a fleshy consistency and colour, finally bright reddish brown; lid obtusely apiculate, *annulus none*; peristome teeth orange-red, cilia in pairs. Dioicous.

HAB. Clay banks, usually by the side of ditches and streams, common. Fr. early spring.

W. carnea and *W. albicans* form in some respects a separate group, distinguished from the foregoing species of this Section, as well as from those of the Section Pohlia, by the wider leaf cells, the very short capsule, and the absence of an annulus. In *W. Ludwigii* and *W. commutata* the cells are indeed as wide in proportion to their length, though somewhat smaller altogether, but in the other species the cells are decidedly narrower (less than 15μ, while in these they are often as much as 20 μ, or even 25 μ), and in all the capsule is larger or more elongated, being larger, if not proportionately of greater length even in *W. gracilis*. *W. carnea* is a pretty little plant, which varies very little, and is easily known by the short, almost uniform stems, the pale green colour becoming dull or reddish when dry, and the very small capsules on short fleshy setae: the absence of annulus and wide cells serve to distinguish it under the microscope in cases of difficulty. *W. albicans* is in almost all cases a taller plant of softer texture, of a whiter and more glaucous colour, and with wider, larger leaves. The vanishing nerve will serve to separate this species when barren from any species of Bryum for which it is at all likely to be mistaken. The seta is hooked so close to the capsule—in this respect differing from most species of the genus—that the neck of the capsule itself often partakes in the bending.

9. Webera albicans Schp. (*Bryum albicans* Wahl.; *Pohlia albicans* Lindb., Braithw. Br. M. Fl.) (Tab. XLI. G.).

In large, very soft, lax tufts, *1–3 inches high, pale whitish or glaucous green*. Stems bright red, slender, flexuose. Leaves usually rather distant, when dry shrunken and narrow, but spreading and little altered in direction, *widely ovate-lanceolate*, acute, upper longer, narrowly ovate-lanceolate, from a narrow, slightly decurrent base; thin, pellucid; margin plane, denticulate in upper half; nerve vanishing below apex; cells rhomboid-hexagonal, *rather large, 15–20 μ wide*, slightly narrower towards margin, hardly altered at base. Seta *tall*, flexuose, slender, about ¾–1 inch long, hooked at summit a little below the neck of the capsule, which is pendulous, shortly and widely pyriform, larger than in *W. carnea*, greenish until ripe, then brown or reddish, wide-mouthed when dry and empty; *annulus none*; peristome teeth pale brownish yellow, cilia 1–2, long. Dioicous. Male flower large, terminal, discoid; perigonial bracts widely spreading.

Var. β. *glacialis* Schp. (*Mnium glaciale* Schleich.). Taller, *more robust*, with more distant, wider leaves, usually *of a duller green*.

Hab. Clay banks, springs, mountain streams, etc., frequent. The var. β on high mountains. Fruit not common, produced in spring or early summer.

A very beautiful plant, known at once by its pale glaucous green tufts, hardly resembled by any other of our mosses, though slender forms of *W. cruda* are sometimes like it in habit, and in its stunted forms it is not unlike *W. carnea*; the narrow cells, rigid texture, etc., of the former would at once distinguish that species, while *W. carnea* almost always has narrower, firmer leaves, of a duller colour and less pellucid. The male flowers are very conspicuous.

The var. *glacialis* in its typical form is a fine and distinct plant, and is very rarely fertile; intermediate forms however are common, and indeed the plants that are found in and about mountain streams generally show some approach to this variety.

I have gathered a form of this variety on the summit of Craig Chailleach, forming magnificent patches, six inches deep, with very rich colouring of bright pale green, rich vinous red, and black, in well defined zones downwards. From *W. Ludwigii* var. *latifolia*, which in some respects much resembles it, it differs in the less decurrent leaves with plane, not recurved margins.

C. EPIPTERYGIUM.

Leaves dimorphous, the larger somewhat distichous, widely oval, the others minute, in two or three rows, alternately with the former; areolation lax, marginal cells in 3–5 rows suddenly narrower, forming a distinct border. Dioicous.

10. Webera Tozeri Schp. (*Bryum Tozeri* Grev.; *Epiptery-gium Tozeri* Lindb., Braithw. Br. M. Fl.) (Tab. XLI. I.).

Plants small, soft, densely gregarious, rarely ½-inch high, pale green or reddish; stems red, slightly branched. Leaves rather distant, *of two forms*, especially on the male plants; the smaller minute, narrowly ovate or lanceolate; the larger *widely oval* or *obovate-rounded, very shortly and acutely acuminate* or *almost apiculate*, slightly decurrent, very narrow at base, thin, soft, pellucid, *entire*, plane at margin; nerve reaching about ⅔ length of leaf, sometimes forked, reddish; cells *large, hexagonal-rhomboid*, thin-walled, the marginal in several rows much narrower, *forming a wide, distinct, reddish border*. Seta short, soft, pale red; capsule sub-pendulous or horizontal, obovate with a short neck, *small*, when dry and empty shortly and widely pyriform with a wide mouth, annulus broad, sub-persistent; peristome small, pale yellowish brown, the inner thin, *with short cilia*. *Dioicous*. Male flowers terminal, sub-discoid.

HAB. Sandy banks and sides of streams; South of England; Ireland; rare. Fruit rare, spring.

A very pretty and distinct plant, which appears to have its headquarters in the Mediterranean region, and is only found in our most southern counties and in one locality in the north of Ireland. It has an aspect not unlike some small forms of Mnium, and also resembles certain species of Bryum; the truly Bryoid cells will distinguish it from the former genus, and from the latter the broad distinct margin at once separates it.

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77. PLAGIOBRYUM Lindb.

Densely tufted, leaves closely imbricated, with lax areolation. Capsule on a short, almost cygneous seta, *very long-necked, gibbous, with the mouth oblique*. Peristome almost as in Webera.

A small genus of mosses of distinct habit and with the capsule gibbous and unequal with an oblique mouth.

DERIV.—*πλαγιο*-(plagio) oblique, slanting, and Bryum. From the incurved capsule.

{ Ls. widely ovate, closely imbricate; nerve not excurrent.....1. *Zierii*
{ Ls. oblong-lanceolate, less imbricate; nerve excurrent.....2. *demissum*

1. Plagiobryum Zierii Lindb. (*Bryum Zierii* Dicks., plur. auct.; *Zieria julacea* Schp., Syn.) (Tab. XLI. J.).

In small, close, soft tufts, *silvery green or whitish above, pale vinous pink below*; ½–2 *inches high*; stems short, with numerous fastigiate *julaceous* branches. Leaves densely imbricated, erect

with the points recurved, little altered when dry, thin, *very concave, rounded-oval or oval-oblong*, shortly and sharply acuminate or cuspidate, margin *plane*, entire or sub-entire, nerve reddish, *vanishing at or below apex;* cells very thin, lax, thin-walled, hexagonal-rhomboid, hyaline in all but the young leaves; comal leaves of the fertile stems longer, large, lanceolate. Seta short, 3–4 lines, arcuate at top, capsule (with the neck) *very long, 2–2½ or even 3 lines, clavate, gibbous above and slightly asymmetrical*, horizontal or sub-pendulous, when old and empty sub-erect; the capsule itself oblong-cylindrical, slightly curved, *the neck once or twice its length*, gradually tapering into the seta; mouth small, *oblique*, pointing downwards; lid conical, apiculate; outer peristome teeth *a little shorter than the processes* of the inner, cilia rudimentary. Dioicous.

HAB. Clefts of moist mountain rocks. Not common. Fruiting in autumn.

Like many dioicous species this pretty moss is much more commonly found barren than fertile; in this state it bears a close resemblance to *Bryum argenteum*, but that species never exhibits the vinous red colour which is usually markedly present in this plant; the cells too are hardly half the size with firmer walls, the nerve vanishes or at least becomes very indistinct soon after reaching half way up the leaf, while in this species it is distinct at least to the base of the acumen, and is frequently percurrent. From the next species it differs in the longer-necked capsule, less curved and swollen, the plane-margined wider leaves, and shorter nerve, and the proportionately longer teeth of the outer peristome. The long, asymmetrical, horizontal fruit is very curious in appearance, and is somewhat variable in length, form and direction. It is only when gathered at just the proper period of maturity that the neck of the capsule can be properly seen; in young capsules, as in old and empty ones, the distinction between capsule and neck becomes indistinct.

The beginner must beware of confusing the present plant with *Bryum filiforme* (*Bryum julaceum* Sm.); the likelihood of so doing, however, arises more from the similarity of their synonymy than from any very close resemblance in the plants themselves; *Bryum filiforme* being a more slender, rigid plant, without the red tinge of the present species, with much narrower cells and quite different fruit.

2. Plagiobryum demissum Lindb. (*Mœsia demissa* Hornsch.; *Zieria demissa* Schp., Syn.)(Tab. XLI. K.).

Resembling the last species; less densely tufted, rather closely gregarious, *shorter, rarely more than ¼ inch high, reddish-brown;* leaves *less imbricated and concave*, rendering the branches less julaceous; *oblong-lanceolate*, acuminate, margin *usually recurved*, nerve (in the upper leaves at least) *excurrent*, cells longer and narrower, especially towards base. Seta strongly arcuate or cygneous, almost geniculate, at summit; capsule *shorter*, yellowish-brown, *1½–2 lines long, more curved, more gibbous and swollen, the neck shorter, equalling the capsule in length*, mouth very oblique; outer peristome teeth *only about half the length of the processes*, cilia present, rudimentary.

HAB. On the ground and among rocks in exposed spots on high mountains, very rare; Ben Lawers and Craig Chailleach, Perthshire. Fr. autumn.

A high alpine moss, differing in the browner tufts without the vinous red of the first species, in the shorter stems, less julaceous branches, more excurrent nerve, and other points. It is a plant likely to be passed over, in the barren state, as a small Bryum, but the fruit is quite distinct; smaller than in *P. Zierii*, yellower, and more curved and irregular, but otherwise much resembling it.

78. **BRYUM** Dill.

Stems producing innovations, usually in pairs, below the flowers, thus becoming repeatedly forked and rendering the plants densely tufted. Leaves usually *more or less ovate* in outline, frequently crowded in a comal tuft, of a thin texture and very little hygroscopic, cells smooth, rather large, *more or less widely rhomboid or hexagonal-rhomboid, rarely linear*, the marginal often very narrow and forming a more or less distinct, sometimes thickened border; nerve usually excurrent. Calyptra narrow, cucullate, soon falling off. Capsule on a long seta, *usually more or less pendulous*, pyriform, but varying from sub-globose to elongate-clavate, annulate, lid conical, *obtuse or apiculate, not rostellate nor rostrate*. Outer peristome of 16 long, lanceolate, undivided teeth, closely articulated, especially in the lower half, internally barred, sometimes slightly perforate; inner thin, pale, consisting of a membrane about half the length of the teeth, to which it sometimes adheres, bearing 16 lanceolate processes alternating with the teeth, perforate or split and gaping along the keel or median line, and usually with 1–3 intermediate cilia opposite each tooth, sometimes rudimentary, *when perfect bearing short transverse appendages at intervals*.

The genus Bryum is one of the largest among mosses, consisting of more than 900 species, to which number additions are frequently being made. It is the one, moreover, which both to student and to systematist offers perhaps the greatest difficulty. One reason for this difficulty lies in the fact that a very large number of the species are separated by very slight and inconspicuous and yet apparently constant characters, such as the shape of the capsule, the structure of the peristome, and the form of the leaf. Each of these characters presents, over all the extent of this large genus, a much more limited range of variation than is found in many far smaller genera, hence the difference exhibited between species and species can often be at the most extremely slight, hard to detect, and no less hard to define. Another and very important difficulty lies in the fact that many species are almost

invariably found in the barren state, and the absence of fruit in a Bryum often almost prohibits its certain identification.

These difficulties would be greatly minimised if the species admitted of classification in groups or sub-genera on clearly defined characters or such as are easily observed; but unfortunately the case is quite the reverse. There is so little correlation between the different parts that any natural classification founded upon more than one organ or structure seems to be out of the question; while, on the other hand, a classification based upon any single structure, such as the inflorescence, peristome or length of the nerve in the leaf, proves entirely arbitrary and unites obviously unallied species while separating others as clearly akin.

The plan I have endeavoured to follow in the succeeding arrangement is to separate off certain distinct groups clearly defined either by a marked habit (such as Anomobryum and Rhodobryum) or by an important character of the peristome (as in Ptychostomum); and to divide the bulk of the species then remaining (Eu-Bryum) into two groups into which they naturally fall, each marked by a general concourse of characters rather than by any one or more clearly defined differences of structure. For convenience of reference these Sections are tabulated below.

One or two suggestions may be of use to the student in the examination of these mosses. To examine the general structure of the peristome, it is frequently sufficient to flatten out an open capsule in water under a cover-glass and to expel the air by warming, but this is not satisfactory when it is required to observe details of structure, nor for the examination of the inner peristome; it is best, therefore, to cut off the whole peristome as near as possible to the mouth of the capsule, when it may be separated easily into two halves and spread out flat on the slide, one half showing the dorsal or outer surface, the other with the inner or ventral surface uppermost. In examining the capsule to determine whether or not it is contracted *below* the mouth, it is absolutely necessary to observe perfectly ripened capsules, and, if possible, such as have lost their lids before gathering; in immature capsules, even where apparently ripe, a contraction invariably takes place below the more firmly textured mouth upon drying, and this will almost always be found to be the case with specimens gathered before the fall of the lid, while capsules on the same tuft which had ripened fully and lost their lids before gathering will show no trace of this contraction. Indeed, it is probably not too much to say that the species in which this contraction is normal in fully ripened capsules, as in *B. turbinatum*, are extremely few and even exceptional. It may be added that very little reliance is to be placed on the obtuseness or acuteness of the lid in this genus, as it often exhibits considerable variation in this respect even within the limits of a single tuft.

The size of the spores will often be found to give a valuable and easily observed character, especially as determining the species of the Section Eu-Bryum from those of the other Sections.

DERIV.—*βρυον* (bryon), a Greek name for some cryptogamic plant.

In reference to the following grouping, one or two preliminary remarks are necessary. Although the distinctive peristome characters of Ptychostomum are of considerable importance, and in some species (*e.g. B. pendulum* and *B. Warneum*) are easily observed and, indeed, conspicuous, there is no clear line of demarcation between the two Sections Ptychostomum and Cladodium, and in the case of certain species it is almost a matter of option in which Section they should be placed. This is the case with *B. Marratii* and *B. mamillatum ;* these I have placed in Cladodium because their affinities appear to be close with certain species of that Section, although on the basis of the peristome alone a place might perhaps equally be claimed for them in Ptychostomum. To a certain extent this is also the case with *B. arcticum*, but here the vertical or oblique lines, although few, are apparently constant, at any rate in our British form.

To examine this structure it is necessary in critical species to separate out part of the peristome, well freed from air, the outer face upwards, and to observe it under a fairly high power with a good illumination. By careful focussing the different layers will be made out usually without difficulty. The outer or dorsal layer of the lower half of the tooth will be recognised by the fine papillae with which it is covered ; it consists in each tooth of a double row of rectangles, each much wider than high (dorsal plates), their adjoining end-walls usually somewhat oblique, so that the line of junction forms a fine zig-zag median line dividing the surface of the tooth from top to bottom. On focussing down the ventral layer comes into view, marked by the strongly projecting stout transverse bars, generally standing out from the back of the tooth in a somewhat semi-circular outline. In Ptychostomum the bars are connected together by rather stout vertical or oblique irregular partitions, sometimes occurring between the lower articulations only, and varying much in number and distinctness. Care must be taken not to mistake for these the fine irregular lines which form a network on the *inner* peristome, and frequently show through the outer teeth, but which will be found on careful focussing to be on a lower, more interior plane. The structure of the teeth may sometimes be observed more clearly by viewing from the inner surface.

Tab. XLII. C. shows a peristome tooth of the Ptychostomum character in *B. pendulum*, but the other species of the group rarely display the connecting partitions so clearly as does that.

A. ANOMOBRYUM. Innovations slender, julaceous; leaves small, sub-equal, concave, closely imbricated; upper cells very narrow, linear. Spores small.

B. PTYCHOSTOMUM. Innovations not julaceous; cells as in Eu-Bryum. Inner peristome imperfect, the cilia being absent or very rudimentary and without appendages, the basal membrane often more or less adherent to the outer teeth. Outer teeth with irregular oblique or vertical lines on the inner surface, connecting the transverse articulations in the lower part of the teeth. Spores large.

C. CLADODIUM. Innovations not julaceous; cells as in Eu-Bryum. Inner peristome as in the last; outer without oblique lines on the inner face of the teeth, simply barred transversely. Spores large.

D. LEUCODONTIUM. Innovations not julaceous; cells as in Eu-Bryum. Inner peristome perfect (except in *B. fallax*), the cilia being mostly well-developed, as long as the processes, with distinct transverse appendages; basal membrane not adherent to the outer peristome. Outer teth pale yellow throughout their length, hardly thickened at base. Spores usually small.

E. EU-BRYUM. Innovations not julaceous (except in *B. argenteum*), cells wider, more or less hexagonal-rhomboid. Inner peristome perfect. Outer teeth pale yellow above, at base thickened, deeper in colour, orange. Spores small.

F. RHODOBRYUM. Leaves in wide terminal rosettes, very large, the lower scale-like. Cells large, hexagonal. Stems tall, robust, with creeping subterranean stolons. Peristome as in Eu-Bryum.

In order to assist in identifying the species of this difficult genus, the following Key has been partly based on more artificial, but more easily observed characters, and should be used in conjunction with the above synopsis. The Keys to the species described under each Section will be found under their respective headings, on the page referred to in the general Key. The letters preceding the reference to the pages indicate the Sections under which the Keys will be found.

1 { Leaves not bordered, at least in the upper part.....2
  { Leaves distinctly bordered with narrow cells.....9

2 { Nerve ceasing in or below apex, or leaves sub-obtuse or acute only.....3
  { Nerve excurrent in a distinct point, ls. acuminate (*B. Dixoni* should be sought here).....9

3 { Upper leaves large, in a rosette, serrate; plant stoloniferous...*33. roseum*
  { Leaves smaller, entire or denticulate only.....4

4 { Branches julaceous with the concave, imbricated leaves.....5
  { Branches not julaceous.....7

5 { Ls. with wide cells.....6
  { Ls. with almost linear cells.....A (p. 347)

6 { Ls. with hyaline points, tufts silvery.....*32. argenteum*
Ls. not hyaline, tufts green or reddish.....*22. capillare* var.

7 { Ls. much shrivelled when dry, distant, either very decurrent, or orbicular and obtuse.....D (p. 356)
Ls. less altered when dry, not markedly decurrent nor distant.....8

8 { Plant small ; ls. wide, obtuse or with wide short point.....B (p. 348)
Plant often tall ; ls. rather long and narrow, or with an abrupt, narrow apiculus.....E (p. 360)

9 { Cilia without appendages, or none (*B. fallax* may be sought here) B (p. 348)
Cilia appendiculate (or fruit unknown).....10

10 { Capsule pale, asymmetric, incurved ; ls. mostly vinous red, distinctly decurrent..... *13. pallens*
Ls. not vinous red, not decurrent, or if so capsule symmetric.....11

11 { Capsule turbinate, much constricted below mouth, smooth when dry *16. turbinatum*
Capsule not markedly constricted below mouth.....E (p. 360)

A. ANOMOBRYUM.

{ Ls. wide-ovate, obtuse or apiculate, not nerved to apex.....*1. filiforme*
Ls. narrower, more acute, nerve usually reaching apex.....*1.* concinnatum*

1. Bryum filiforme Dicks. (*Anomobryum filiforme* nonnull. auct. ; *Bryum julaceum* Sm., plur. auct.) (Tab. XLII. A.).

In dense tall tufts, 2–4 inches high, pale glossy green or yellowish, pale brown below, stems and branches slender, filiform, *rather rigid, julaceous*, with the leaves appressed and closely imbricated, hardly altered when dry, *concave, oval or oval-oblong, obtuse or shortly and obtusely apiculate*, margin plane, entire or obsoletely denticulate at apex, nerve yellowish, *vanishing at or some distance below the summit ;* cells somewhat variable in width, the basal shortly and widely rectangular or sub-hexagonal, the upper *linear-rhomboid, or narrowly linear-vermicular, incrassate*. Comal leaves of the fertile stems longer, ovate-lanceolate, acute. Seta red, about 1 inch long. Capsule *sub-pendulous, clavate, very slightly decurved*, neck tapering, shorter than the capsule itself, altogether 1½-2 lines long, reddish brown, hardly contracted below the mouth when dry, lid mamillate, smooth, glossy. Peristome yellow, small ; cilia appendiculate. *Dioicous*. Male flowers gemmiform.

Var. *β. juliforme* (*Anomobryum juliforme* Solms. ; *Bryum juliforme* Schp., Braithw. Br. M. Fl.). *Shorter*, more compact, yellowish. Leaves narrower, *slightly apiculate, point recurved*, denticulate at apex ; upper cells *narrower*, more incrassate. Capsule slightly smaller, less pendulous, *usually horizontal*, peristome orange at base.

Hab. Wet rocks in mountain streams, common. The var. β among rocks in drier places in the south; Carbiss Bay, Cornwall, sterile (*Curnow*). Fr. rare, late summer and autumn.

A very distinct species, with little resemblance to any other moss but the sub-species *concinnatum*; *B. argenteum* differs in the less glossy, softer tufts, with the apex of the leaves white and diaphanous, and the cells quite different; *Plagiobryum Zierii* is known by the reddish tinge of the plants and by other points detailed under that species.

The var. *juliforme* appears to be little more than a stunted form growing in drier and hence less favourable habitats; even in the typical plant there is considerable variation in the length and width of the cells and the apex of the leaves, and at the most the differences exhibited by the variety in these respects are very slight.

***Bryum concinnatum** Spruce (Tab. XLII. B.).

Differs from the above in the stems *more slender, softer and more flexuose*, the leaves *less closely imbricated*, less concave, narrower, with *more acute, slightly acuminate points*; nerve *usually reaching to apex; cells wider, narrowly rhomboid-hexagonal, with thinner walls. Fruit unknown.*

Hab. In similar situations; rare.

The soft texture, acute leaves, and laxer areolation are the main features of this plant, and the nerve is rather longer. None of these points are, however, of great importance, since they are those in which *B. filiforme* is most variable; and forms occur of an intermediate character.

B. PTYCHOSTOMUM.

Key to Ptychostomum and Cladodium.

1 { Nerve ceasing some distance below apex.....2
  { Nerve reaching apex (or very nearly) or excurrent.....3

2 { Ls. elliptic, obtuse; capsule short, sub-globose.....*6. Marratii*
  { Ls. wider, usually shortly pointed; capsule oval-oblong...*5. calophyllum*

3 { Ls. scarcely bordered, nerve not or scarcely excurrent.....4
  { Ls. with a distinct border, or nerve distinctly excurrent.....5

4 { Spores 18-27 μ.....*8. lacustre*
  { Spores about 40 μ or more.....*3. Warneum*

5 { Dioicous .....*13*. fallax*
  { Autoicous or synoicous.....6

6 { Capsule incurved, mouth oblique, small; seta 1½ inches or more
  { .....*11. uliginosum*
  { Capsule symmetric or rarely incurved, mouth not oblique.....7

7 { Nerve rather longly excurrent, ls. narrowly tapering, red at base.....8
  { Nerve not or only shortly excurrent, ls. shortly pointed, rarely red
  { at base.....9

8 { Peristome distinctly Ptychostomoid.....*2. pendulum*
Peristome of Cladodium.....*10. inclinatum*

9 { Papillae of dorsal plates of peristome in fine transverse striae *7. purpurascens*
Outer surface of teeth without transverse striae.....10

10 { High alpine mosses.....11
Mosses of sandy shores.....12

11 { Tufts reddish, ls. ovate-lanceolate, nerve very stout, red...*4. arcticum*
Tufts dull green, ls. widely ovate, nerve not red, very shortly excurrent.....*12. lawersianum*

12 { Margin distinctly recurved, peristome of Cladodium.....*9. mamillatum*
Margin faintly recurved, peristome of Ptychostomum.....*3. Warneum*

2. Bryum pendulum Schp. (*B. cernuum* B. & S., *non* Lindb., nonnull. auct.) (Tab. XLII. C.).

This species resembles *B. inclinatum* closely in everything but the peristome. Certain differences have been alleged to exist, as that the leaves are broader in the present species, the arista longer, the capsule wider, the spores smoother; but except that the capsule is perhaps on the whole usually (but not by any means constantly) a little wider and more inflated in appearance than in *B. inclinatum*, I do not think there is the slightest reliability to be placed on any of these characters. In *B. pendulum* the teeth of the outer peristome have the Ptychostomum character, with the connecting lines *very numerous and conspicuous*. These lines are visible through the teeth when viewed from the outside, and they give an appearance of an irregular net-work to the face (Tab. XLII. C. 6). Inner peristome adherent to the outer for the greater part of its length, processes *widely gaping* at the clefts, cilia absent or very rudimentary. Spores 25–35 μ. Synoicous, sometimes sub-autoicous.

HAB. Walls, dry heaths, sand, etc. Not uncommon, especially near the sea. Fr. spring and early summer.

Philibert first pointed out the peculiarity of the structure of the peristome teeth in *B. pendulum*, affording a ready method of separating it from *B. inclinatum*, which has them simply articulate with transverse bars, without oblique connecting lines, and it is quite clear that until this was recognised the species was very imperfectly understood. Examined under this light, two out of every three early herbarium specimens labelled *B. pendulum* usually turn out to be *B. inclinatum*, while on the other hand plants labelled *B. inclinatum* and even *B. caespiticium* prove to belong here.

It varies greatly in size and foliation, as does *B. inclinatum*, and it would be altogether unsafe to attempt to determine barren plants with any degree of certainty.

The var. *compactum* Schp., a small dense form, has been gathered by Mr. W. Ingham in Upper Teesdale.

The inflorescence is usually synoicous, but occasionally gemmiform male flowers are found, mixed with the others.

3. Bryum Warneum Bland. (Tab. XLII. D.).

Short, tufted, reddish brown, stems with numerous innovations which are sometimes long and slender. Leaves not much crowded, somewhat flexuose and erect when dry, *widely ovate or ovate-lanceolate*, shortly acuminate, with a denticulate, cuspidate point, the greater part formed by the *slightly excurrent*, reddish nerve. Margin *almost plane or very narrowly reflexed;* cells resembling those of *B. inclinatum*, but wider, shortly hexagonal or hexagonal-rhomboid, not red at base, the marginal narrower, forming a slender border. Seta long, 1–2½ inches, capsule reddish-brown when ripe, *abruptly pendulous, shortly and widely ovate-pyriform, very narrow at the mouth*, lid small, conical; peristome resembling that of *B. pendulum*, the oblique partitions often less evident, but always numerous; processes of inner peristome *narrowly slit* at the clefts, not widely gaping; cilia 3–4, very rudimentary or abortive. Cells of exothecium *strongly* incrassate, Spores very large, 40–48 μ. Autoicous, male flower among the comal leaves; rarely synoicous.

Hab. Sandy ground or mud by rivers or seashores. Rare. Fr. all the autumn.

This species may be distinguished from *B. pendulum* by the larger spores, narrowly slit processes, and small-mouthed capsule, which ripens some months later in the year. The leaves too are wider and shorter than in *B. pendulum*, more shortly acuminate, with the nerve very shortly excurrent, the cells wider, with a much less distinct border; the capsule and neck both shorter, the former more widely oval. *B. arcticum* grows in quite different stations, and differs also in the shorter seta, strongly reflexed margin of the leaves, paler, longer-necked capsule, etc. In general appearance it is perhaps most like *B. lacustre* and *B. mamillatum*, but in addition to the Cladodium peristome the former species has the leaves scarcely bordered, a shorter nerve, and much smaller spores; while *B. mamillatum* also has the Cladodium peristome, and a wider-mouthed capsule, ripening much earlier in the year.

4. Bryum arcticum R. Br. (Tab. XLII. E.).

Densely gregarious, *deep vinous red*. Stems *very short*, ¼-inch high, little branched. Leaves ovate-lanceolate, shortly acuminate, not red at base; margin *strongly recurved*, slightly toothed at apex; nerve very stout, reddish, excurrent in a short entire or denticulate point. Cells incrassate, rather wide above, at margin in several rows narrow and incrassate, forming a distinct reddish sometimes thickened border. Seta ½–1 inch high, red, glossy, bent near the capsule. Capsule from a *rather long, narrow neck* abruptly widened, oval-pyriform, usually somewhat gibbous and incurved, narrow at mouth, *pale brown*, pendulous, when old sub-erect; lid conical, small. Cells of exothecium only slightly incrassate. Median line of dorsal surface of teeth straight or slightly zig-zag; lamellae united by *very few partitions, usually only a single median vertical or oblique one between each pair* in

the lower half of the tooth only. Processes slender, *very narrowly slit;* cilia very rudimentary. Spores 25–35 μ. Synoicous.

HAB. On the ground on high mountains; very rare; Ben Lawers; Craig Chailleach. Fr. late summer and autumn.

The colour and the high alpine habitat of this moss render it easy of recognition from most of our species; *B. purpurascens* is a taller plant, with leaves narrowly bordered, a longer, more symmetrical capsule, and the papillae of the dorsal plates of the peristome arranged in fine horizontal lines. *B. lawersianum* differs in the colour, the peristome, and other points. It is a pretty and distinct species, occurring on the high mountain ranges and in the northern regions of Europe and N. America.

C. CLADODIUM.

For Key, see under B. PTYCHOSTOMUM.

5. Bryum calophyllum R. Br. (Tab. XLII. F.).

Loosely tufted, with few radicles, pale or olive green. Leaves distant, small, the terminal considerably larger, forming when dry an obtuse rounded tuft; all *very concave, widely elliptical or sub-orbicular, obtuse or shortly and obtusely apiculate, not bordered*, margin entire or faintly sinuose at apex, plane or very narrowly recurved below; nerve strong below, *vanishing below or more rarely just reaching apex;* cells shortly and widely rectangular-hexagonal, *hardly altered at margin;* comal leaves of the fertile stem narrower, ovate-oblong, acuminate. *Seta 1–1½ inches long, firm;* capsule exactly pendulous, *oval-pyriform with a short, sometimes almost obsolete neck*, the mouth rather narrow; lid conical, mamillate; peristome teeth *yellow*, darker at base, finely perforated along the median vertical line; cilia rudimentary. Spores 30–40 μ. Autoicous; male flower gemmiform, just below the fertile flower.

HAB. Sandy shores and damp places, rare. Fr. summer and autumn.

This species and *B. Marratii* are very distinct in the extremely concave, obtuse leaves, of very different outline from the typical Bryum leaf. The capsule of *B. Marratii*, sub globose-pyriform and acuminate with the pointed lid, and the narrower, oblong, more obtuse leaves easily separate that species from the present; *B. Warneum* differs in the longer, cuspidate, serrate points of the leaves, in the exothecium cells with thinner walls, and in the distinct structure of the peristome teeth. The fruit ripens over a long period of the year.

6. Bryum Marratii Wils. (Tab. XLII. G.).

Resembles *B. calophyllum*, but differs in the *narrower, oval-oblong leaves*, which are *more obtuse*, entire, *very concave, somewhat cucullate at apex*, the nerve rather narrower, vanishing below apex. Seta shorter, *more slender*, capsule *smaller, globose-pyriform with a very short, tapering neck, apiculate with the rostellate, acuminate lid*, sub-pendulous, small-mouthed, dark reddish brown; annulus broad, persistent; peristome teeth narrow, *deep orange-red*, lamellae with a few partitions towards base of teeth, processes not cleft; cilia rudimentary. Spores 35–40 μ. Autoicous; male flower gemmiform.

HAB. Sandy sea-shores. Rare. Fr. late summer and autumn.

Readily known from *B. calophyllum* by the characters pointed out under that species. The deep red colour of peristome is also characteristic, and the capsule is smaller, and of a very different form from that of any of the allied species. The Ptychostomum structure of the peristome is sometimes far from evident, and on account of this and the close resemblance in leaf characters to *B. calophyllum*, I have thought it best to let it stand here.

7. Bryum purpurascens B. & S. (*Pohlia purpurascens* R. Br.) (Tab. XLII. I.).

In tufts, ½–1 inch high, *brown or purplish red above*. Leaves resembling those of *B. inclinatum* but *rather wider, more shortly acuminate*, not red at base, margin *less recurved*, bordered with several rows of narrow, yellow cells, slightly denticulate at apex, nerve yellowish, *shortly excurrent*, or vanishing at or below apex; cells rather large, thin-walled. Capsule on a *rather short seta* (1–1¼in. long), *pendulous, oblong-pyriform*, symmetrical, with the neck about equal in length to the capsule; lid convex or slightly mamillate; peristome teeth deep yellow, darker at base, resembling those of *B. inclinatum*, but with the papillae of the dorsal surface arranged *in transverse lines*. Processes rather widely cleft. Cells of exothecium incrassate. Spores 30–35 μ. Synoicous.

HAB. Crevices of limestone rocks, nr. Litton, Yorkshire, 1879 (*Whitehead*).

I have seen no British specimens of this plant; there are none now existing in Whitehead's herbarium. It is a distinctly boreal species, not I think recorded south of Scandinavia. It seems remarkable that it should appear in a single station in Yorkshire at a quite inconsiderable altitude. The colour, the regular, symmetrical capsule, and the transversely striate outer surface of the teeth, are the chief characters. It must however be remembered that several others of the allied species, including *B. inclinatum* and *B. pendulum*, sometimes show the same vinous red colour.

Whitehead's plant was described at first as a new species, *B. rufum*, by Fergusson, but Mitten and Braithwaite subsequently referred it to the present species.

8. Bryum lacustre Brid. (*Mnium lacustre* Bland.) (Tab. XLII. H.).

Loosely tufted, more or less reddish, short,. Lower leaves widely ovate, upper *ovate, shortly acuminate, concave,* margin entire or nearly so, revolute usually almost to summit, not bordered or with a faint border of narrow cells, nerve reddish, *ceasing below apex or percurrent, rarely a little excurrent;* cells short, wide, not much narrowed at apex. Seta slender, capsule brown, *small, shortly pyriform,* with a neck shorter than the capsule, small-mouthed, inclined, more rarely pendulous, when dry and empty wide-mouthed; lid apiculate, peristome small, pale; teeth yellow, orange at base. Processes rather widely cleft. Cilia rudimentary. Cells of exothecium rather thin-walled. Spores 18–27 μ. *Synoicous.*

HAB. Sandy places, rare. Fr. summer.

In habit and leaf this comes very near *B. Warneum,* but the peristome is that of the Section Cladodium, and by this it may be known at once. *B. calophyllum* and *B. Marratii* are at once known by the leaf form; *B. mamillatum* by the inflorescence, the thick border to the leaves, and the large spores; *B. lawersianum* by the strong border, the alpine station, the colour, etc.; *B. inclinatum* by the narrower leaves with more acuminate points and more excurrent nerve, and the cells at apex narrow.

9. Bryum mamillatum Lindb. (Tab. XLII. J.).

In dense, low, dark green tufts. Leaves ovate-lanceolate, variable in width, not red at base, concave, shortly acuminate; margin narrowly recurved, denticulate at apex. Nerve *stout,* yellowish brown, excurrent in a short toothed point. Cells rather thin-walled, lax, at margin in several rows narrow, forming a thickened yellowish border. Seta 1–1½in. long, reddish brown. Capsule with a short, scarcely curved neck *turgidly oval, symmetrical,* very slightly or not at all narrowed below the rather wide (but variable) mouth when dry; dull dark brown. Lid *plano-convex, sometimes almost flat, usually with a distinct blunt apiculus.* Cells of exothecium rather wide, more or less incrassate. Peristome pale orange; teeth *not red at base;* structure of Cladodium, or rarely here and there a single oblique partition, usually at the base of a tooth; inner peristome orange, free or scarcely adherent to the outer; processes narrowly cleft. Cilia rudimentary. Spores *very large,* 40–55 μ or more. Autoicous, some plants male only.

HAB. Very rare. With *Juncus Gerardi,* etc., on damp sandy soil, Hunstanton Links, Norfolk, 1902 (*Rev. W. E. Thompson*); Cleethorpes, Lincolnshire. Fr. summer.

Although the Norfolk plant exhibits some slight differences from Lindberg's type, they are not such in my opinion as to warrant us in creating

a new species for it, and this view was confirmed by Dr. Hagen, who had probably a greater knowledge of the North European Brya than any other bryologist of his time.

Previously *B. mamillatum* had only been recorded from the Baltic, on the sandy shores of the islands of Gothland and Aland, and a single station on the Pomeranian coast. It is a most interesting species, having the peristome teeth almost exactly as in Cladodium, but here and there showing a connecting partition, thus affording a link with Ptychostomum. The teeth are only slightly deeper in colour, not red, at the base, by which they are distinguished from those of *B. inclinatum* and others. The form of the capsule is also a distinct character, and is more like that of *B. Warneum*, *B. lacustre*, and some forms of *B. pendulum*. The latter differs at once in the peristome teeth, as does also *B. Warneum*, which is also of a browner hue, with the leaf margin less recurved, the mouth of the capsule smaller, the lid more conical, the exothecium cells usually more strongly incrassate. *B. lacustre* resembles it in the peristome, but the spores are much smaller, the lid smaller and more pointed, the leaves less bordered, and the inflorescence synoicous.

The spores in *B. mamillatum* are larger than in any other species of Bryum of which I have seen descriptions. Limpricht describes them as 32-35 μ, but in Lindberg's original specimens from Gothland, at Kew, where there are very few spores left, I found them to average 35-38 μ, with a few up to 45 μ; in Bomansson's specimens from Aland they measured 40-50 μ. In the Norfolk plant they average 48 μ, many reach 55 μ, and a few as much as 62 and 67 μ. I am inclined to think that the smaller measurements are chiefly due to the capsules from which they are taken having been imperfectly ripened; this is certainly the case with most of the capsules in Lindberg's specimen. As in most species of Bryum with large spores, they are golden brown by reflected light, but green when viewed by transmitted light, on account of the chlorophyll they contain.

10. Bryum inclinatum Bland. (*Pohlia inclinata* Sw.) (Tab. XLII. K.).

In close compact tufts or wide patches, densely interwoven below with tomentum; deep or olive green. Leaves frequently interruptedly tufted, the comal crowded, numerous, erecto-patent, when dry *erect and appressed*, forming an oval tuft; *ovate-lanceolate* from a rather narrow *red* base, *gradually and acutely acuminate above*, usually widest about the middle; margin *reflexed to near apex*, entire or slightly denticulate at the point, nerve *excurrent in a long denticulate arista or shorter cuspidate point*; cells at base lax, rectangular, above hexagonal-rhomboid, $\frac{1}{4}$ about twice as long as broad, narrower towards margin and apex, 3–5 rows at margin very narrow and elongate, *forming a distinct yellowish border reaching to apex*. Seta *1–1½ inches long*, capsule brown or reddish brown, *oblong-pyriform or clavate*, sometimes a little curved, tapering to a distinct neck, subpendulous or inclined, with a narrow mouth; lid small, apiculate; peristome teeth yellow, deep orange or red at base, *without oblique connecting lines* on inner face; inner pale, basal membrane adherent to the teeth, processes free, widely gaping at clefts, cilia none or very rudimentary. Cells of exothecium incrassate. Spores 18–24 μ. Synoicous or autoicous.

HAB. Dry heaths, walls, etc. Frequent. Fr. summer.

This species externally resembles several others of the genus, notably *B. pendulum*, *B. caespiticium*, *B. pallescens*, *B. intermedium*, *B. affine*, and *B. provinciale*. The difference in the peristome teeth pointed out under *B. pendulum* will at once distinguish that species, and indeed forms the only constant distinctive character; all the others differ in the well-developed, appendiculate cilia; differences of inflorescence are often adduced, but the inflorescence in both *B. inclinatum* and *B. pendulum* is too variable to give these much practical value. The cells in *B. caespiticium* are usually longer and narrower, the leaves generally broadest *below* the middle and more gradually tapering; and the present species is for the most part a larger plant with larger leaves than any of them except *B. provinciale*; but on the whole the peristome must be considered the most satisfactory character. *B. provinciale* differs also in the leaves more regularly arranged in interrupted tufts, wider, especially in the upper part, more rapidly pointed so that the apex is broader, with wider areolation at the point.

Looser, more elongated forms occasionally occur, with the leaves less crowded and somewhat twisted when dry. Although the capsule is sometimes described as contracted below the mouth, I have never found it so except in capsules which had dried when slightly immature.

The base of the teeth of the outer peristome is frequently of a very deep red.

11. Bryum uliginosum B. & S. (*Cladodium uliginosum* Brid.; *Bryum cernuum* Lindb., Braithw. Br. M. Fl., *non* B. & S.) (Tab. XLIII. A.).

Somewhat resembling *B. inclinatum;* the innovations more slender, with laxer leaves, the comal tufts less distinct. Leaves much resembling those of *B. inclinatum*, but *less narrowly pointed*, with the nerve *more shortly excurrent;* border *thickened*, of 2–3 layers of cells; and recurved. Seta *long*, $1\frac{1}{2}$ to nearly 2 inches, capsule sub-pendulous, oval-pyriform, *incurved, and gibbous at back*, pale brown, *neck long, narrow, distinct, tapering;* mouth *small, oblique*, lid convex, acute; peristome teeth *pale yellow, scarcely deeper in colour at base*, densely barred; cilia absent or rudimentary. Spores 25–32 μ. Autoicous; male flower gemmiform, below the fertile flower.

HAB. Bogs and damp sandy places. Rare. Fr. late summer.

The asymmetrical, curved and gibbous capsule, with the small mouth pointing obliquely downwards, together with the long neck and the imperfect inner peristome, form the best marks by which this species may be known. The shape of the capsule is not unlike some forms of *B. pallens*, but that species wants the small, oblique mouth, the peristome is usually perfect and the inflorescence dioicous. The habitat is usually a safe guide as compared with *B. inclinatum;* the peristome teeth are also less thickened at the base than in that and most species, and are consequently little or no deeper in colour there than above, so that the species is, like the next, in some degree intermediate between this Section and the following one.

12. Bryum lawersianum Philib., Rev. Bry. 1899, p. 99. (Tab. XLIII. B.).

In small tufts or gregarious, dull green, not reddish, stems short. Leaves *small*, the lower very widely ovate or rounded, the upper narrower, ovate, *all very shortly pointed;* reddish at base; margin narrowly recurved; nerve excurrent in *a very short* scarcely denticulate point; cells firm, somewhat incrassate, at margin in several rows narrow, forming a distinct border. Seta short, $\frac{3}{4}$–1 inch, capsule dull brown, sub-pendulous, *symmetrical*, oval with a rather wide neck of the same length; lid convex, apiculate. Peristome pale yellow, teeth *not darker at base*, structure as in Cladodium; inner peristome more or less adherent, processes very slender, very narrowly slit, cilia *absent*. Cells of exothecium *thin-walled*. Spores 24–32 μ. Synoicous.

Hab. On bare earth, Ben Lawers, altitude about 3,500ft., 1899 (*Nicholson, Salmon and Dixon*). Fr. late summer.

The position of this plant is rather doubtful. Philibert compared it with *B. arcticum*, but Hagen considered it to be extremely near to *B. Lindbergii* Kaurin, a species only found in one or two localities in Norway, which like our plant combines to some extent the characters of Cladodium and Leucodontium. *B. Lindbergii* however has much smaller spores, 18-22 μ, and fairly well developed cilia, the inflorescence also is autoicous. *B. lawersianum* seems to belong more distinctly to Cladodium. The teeth pale at the base, and the wider, less tapering, shortly pointed leaves distinguish it from *B. inclinatum*, the colour and the non-striate papillae of the dorsal plates from *B. purpurascens;* the colour, the distinct border of the leaves, narrower capsule, and paler peristome, from *B. lacustre;* the form of capsule, inflorescence, habitat, and other points from *B. mamillatum;* the symmetrical capsule, short seta, and synoicous inflorescence from *B. uliginosum*, and *B. fallax*. The spores in well ripened capsules are rather larger than those measured by Philibert.

D. LEUCODONTIUM.

[The species comprised under this Section form a natural group, marked by the peristome, which has almost always perfect appendiculate cilia as in Eu-Bryum, but the outer teeth instead of being orange at the base are of the same pale colour throughout, being little thickened at their insertion. Besides this there is a characteristic appearance common to the plants, all of them having pale capsules and rather wide leaves, obtuse or shortly pointed only, not narrowly acuminate, and with the nerve, when at all excurrent, less so than in most of the species of Eu-Bryum. The cells also are usually wider, and the leaves more flaccid and more shrunken when dry; and all the species are found in watery situations, and are dioicous.]

1 { Cilia without appendages, rudimentary.....*13*. fallax*
  { Cilia well-developed, almost always appendiculate.....2

2 { Nerve ceasing below apex; ls. crisped when dry.....3
  { Nerve excurrent, or nearly so; ls. scarcely crisped.....4

3 { Leaves orbicular, obtuse.....*15. cyclophyllum*
  { Leaves acute, with long decurrent wings.....*14. Duvalii*

4 { Capsule asymmetric, not constricted below mouth; plant often reddish *13. pallens*
  { Capsule symmetric, strongly constricted below mouth when dry *16. turbinatum*

13. Bryum pallens Sw. (Tab. XLIII. D.).

Extremely variable in habit, usually *with some tinge of red*, frequently bright rose red; loose or compact, ½–3 inches high, leaves soft, densely crowded or distant, erecto-patent, carinate, concave, *strongly decurrent*, when dry *somewhat crisped and flexuose*, in the compact forms incurved and catenulate; oblong-lanceolate or widely ovate, *shortly pointed*, with the reddish nerve excurrent in a short mucro, or vanishing at or just below the apex; cells *lax*, sub-hexagonal, with firm, often thickened walls, *pellucid*; margin entire or sub-denticulate at apex, recurved to near summit, border *thickened, clearly defined, brownish, revolute*. Seta often long, capsule inclined or sub-pendulous, rarely sub-erect, pale brown, *pyriform with a long tapering neck*, the whole often slightly curved and gibbous above; mouth *wide*, not oblique; lid widely mamilllate or convex. Peristome *pale yellow*; cilia *perfect, appendiculate*, rarely less developed. Spores 16–25 *μ*. Dioicous. Male flower gemmiform.

Var. *β. speciosum* Schp. (*B. speciosum* Voit; *B. rubricosum* Stirt. in Ann. Scot. Nat. Hist. vi, 121). *Tall, robust, bright green above*, reddish brown below. Leaves *large, wide, obovate-spathulate, rounded and slightly apiculate at apex*, cells lax, wide, chlorophyllose, border *narrow*, not reaching apex, nerve slightly excurrent in an often recurved mucro. Capsule larger, on a longer seta; lid smaller. Rarely fruiting.

Var. *γ. euryphyllum* D. A. Jones (in Journ. of Bot. 1917, p. 266). Stems short, leaves *large, very broad, concave, widely pointed and often* obtuse, nerve percurrent or vanishing below apex, rarely shortly excurrent, cells *smaller*, often subquadrate.

HAB. By streams and wet places, especially on clay. Common. The var. *β* on high mountains; Ben Lawers. The var. *γ* in sandy detritus by R. Glaslyn, N. Wales. Fr. summer.

One of the most polymorphous species of the genus. The stems at one time are stout and robust, with leaves 1½ lines long, at others slender, almost filiform, with narrow, almost minute leaves; sometimes the tufts are very loose and soft, sometimes they are compact, rigid, and brittle. The brilliant rosy tint which often renders the tufts very conspicuous is mostly lost in drying.

The capsule much resembles that of *B. uliginosum*, but has a wider, not oblique mouth and lid. In rare cases it is sub-erect and curved, resembling that of Funaria.

B. Duvalii differs in the wider leaves of softer texture, more distant, more widely and strongly decurrent, with almost plane, not thickened margins and shorter nerve. *Bryum turbinatum* is known by the leaves less decurrent and the very differently shaped capsule.

The var. *speciosum* is a very distinct plant, resembling small forms of *B. turbinatum* var. *latifolium*, but differing in the less concave, not cucullate apex of the leaves, and the more excurrent nerve.

The var. *euryphyllum* is much smaller, but with somewhat similar leaves, which are most frequently obtuse, and with much denser areolation. It has a close resemblance in habit and leaf form to *B. cyclophyllum*, but the leaves there are suborbicular, and the cells wider.

It may be remarked that here, as in *B. Donianum*, the border of the leaves is, when well developed, more distinct and clearly defined, even when viewed on the face and without making a section, than is the case with the species having non-thickened borders. The border is, however, exceedingly variable, and in some forms entirely wanting. *B. origanum* Bosw., which certainly belongs here, not to *B. lacustre* to which I referred it in Ed. I., is one of these forms.

***Bryum fallax** Milde (Tab. XLIII. C.).

Closely resembling certain forms of *B. pallens ;* leaves very shortly pointed, with a narrow, *not thickened border ;* capsule pendulous or inclined, pyriform, with a long neck becoming plicate when dry, small-mouthed ; outer peristome as in *B. pallens*, inner adherent to the outer, cilia *none or very rudimentary*. Spores 17–22 μ. *Dioicous*.

Hab. Damp places, very rare ; Sussex and Snowdon (*Mitten*) ; Lancashire ; Perthshire. Fr. late summer.

The imperfect peristome is the only constant character separating *B. fallax* from *B. pallens ;* the other characters, if somewhat regularly combined in the present plant, may all be found at one time or another in *B. pallens*, and as in that it is not very uncommon to find the cilia but partially developed, the gap between the two is almost entirely bridged over. I have therefore felt compelled to reduce it to a sub-species of *B. pallens*, in spite of the inconvenience of removing it from the Cladodium Section, to which by the peristome it naturally belongs. When at its best it is scarcely to be distinguished from *B. uliginosum*, but by the dioicous inflorescence and somewhat larger and less oblique mouth of capsule.

14. Bryum Duvalii Voit (Tab. XLIII. E.).

In very lax *soft tufts*, resembling the more slender, looser forms of *B. pallens*, *pinkish green*. Leaves *very distant*, when dry shrinking and flexuose, *cordate-ovate, or widely ovate-lanceolate, longly and widely decurrent, lower obtuse, upper shortly pointed*, nerve *reaching almost to apex or ceasing some distance below ;* margin almost plane, entire ; cells *wide*, short, hexagonal-rhomboid, of soft texture ; the marginal in about two rows of narrow cells, forming an indistinct border. Capsule pendulous, oblong-clavate, yellowish-brown. Dioicous. Male flower sub-discoid.

HAB. Springs on mountains, rare ; sterile in Britain. Fr. late summer.

A very marked species, readily known by its distant, widely and strongly decurrent leaves, giving the stems the appearance of being winged. Lax red aquatic forms of *B. pallens* are the only plants liable to be confused with it, but they are not likely to afford difficulty.

15. Bryum cyclophyllum B. & S. (*Mnium cyclophyllum* Schwaeg.) (Tab. XLIII. F.).

Pale bright green, in loose, soft tufts, stems short with slender branches. Leaves *distant, small,* the comal rather larger, few in number, variously spreading, *not or scarcely decurrent ;* when dry curled ; all *broadly obovate or sub-orbicular, concave, obtuse, slightly cucullate,* entire ; nerve thin, *vanishing below apex ;* cells *wide,* soft, hexagonal-rhomboid, marginal in 1–2 rows, elongated, narrow, forming a weak border. Capsule on a rather short seta, *shortly pyriform,* pale, wide at the mouth and contracted below it. Cilia appendiculate. Dioicous.

HAB. Marshes and sides of pools, very rare. Scotland ; Lake District. Fr. summer.

This is one of the most distinct species of the genus, the rounded, quite obtuse leaves being unique among our species ; *B. Marratii* and *B. calophyllum* most nearly approach it, but the leaves are narrower and of a different colour and texture in those plants.

16. Bryum turbinatum Schwaeg. (*Mnium turbinatum* Hedw.) (Tab. XLIII. G.).

Densely tufted, tall or short, reddish, robust ; often with long straight innovations bearing sub-equal leaves. Leaves crowded, *appressed when dry,* gradually larger upwards, very shortly decurrent, *oval, shortly acuminate,* carinate ; margin entire or faintly denticulate at apex, plane or recurved, nerve stout, *excurrent in a short point, red ;* cells *rather large,* rectangular-rhomboid, marginal narrow, forming a more or less distinct coloured border. Seta about one inch long, somewhat flexuose, hooked above, rendering the capsule pendulous. Capsule *short and thick,* when fully ripe *turbinate, strongly constricted below the very wide mouth,* then inflated and rapidly tapering into the seta ; lid large, mamillate. Peristome teeth long ; cilia of inner longly appendiculate. Dioicous.

Var. *β. latifolium* B. & S. (*Mnium latifolium* Schleich. ; *B. Schleicheri* var. *latifolium* Schp., Syn.). *Tall and very robust, 2–5 inches,* with *long, straight, almost unbranched, tumid stems ;* yellowish green ; leaves *very large, roundish oval, concave,* sub-cucullate at apex, *sub-obtuse and apiculate,* more denticulate and with the border more strongly marked, nerve usually ceasing at or below apex. Capsule longer, on a short seta.

HAB. Wet sandy places; rare. The var. β more rare, and very rarely fertile; Scotland. Fr. summer.

Somewhat resembling *B. pallens* in leaf, this moss is quite distinct in the fruit, which is shorter, more inflated, very much constricted below the wide mouth, and quite symmetrical, not curved nor gibbous. The var. *latifolium* is a very distinct form, notable for its large wide leaves, so concave that they will not flatten out at the apex; intermediate forms, however, occur; I have gathered one with the Rev. C. H. Binstead, in Brecon, as tall and robust as the variety, but with narrower, though equally large leaves.

E. EU-BRYUM.

1 { Plant silvery white; stems julaceous, nerve short.....*32. argenteum*
Plant red, green or brown, not silvery.....2

2 { Leaves not (or scarcely) bordered above.....3
Leaves distinctly bordered with narrow cells.....12

3 { Margin strongly toothed above; ls. in interrupted tufts on stem *21. provinciale*
Margin almost entire, or denticulate at apex only; ls. uniform.....4

4 { Ls. minute, concave, widely ovate, very shortly pointed, margin plane *31. Dixoni*
Ls. larger, or if small acute or acuminate, with margin recurved.....5

5 { Nerve excurrent in a longish arista.....13
Nerve shortly or not excurrent.....6

6 { Nerve scarcely or not excurrent; apex sub-acute or obtuse; ls. imbricate when dry.....7
Nerve distinctly excurrent; apex acute or acuminate.....9

7 { Leaves shining, usually reddish; cells under 10 μ wide...*27. alpinum*
Leaves less shining, with wider points; cells wider.....8

8 { Leaves distinctly cucullate..... *29. Muehlenbeckii*
Leaves pale or reddish, usually mixed with gemmae, hardly cucullate *28. gemmiparum*

9 { Capsule abruptly rounded at base.....*25. atropurpureum*
Capsule more or less tapering towards base.....10

10 { Cells about 5 μ wide; lid obtuse, scarcely apiculate.....*26. murale*
Cells 10-12 μ wide; lid apiculate.....11

11 { Leaves serrulate at apex; barren plant with mulberry-like gemmae *24. erythrocarpum*
Leaves entire at apex.....*30. Mildeanum*

12 { Leaves more or less obtuse and cucullate; very concave...*17. neodamense*
Leaves acute or acuminate.....13

13 { Leaf-border very distinctly marked, bistratose.....*23. Donianum*
Border not thickened.....14

14 { Leaves with shortish points, nerve rather shortly excurrent 15
Leaves longly cuspidate or aristate.....18

15 { Plant small; capsule short.....*24*. rubens*
Plant usually tall; capsule longer.....16

16 { Synoicous .....*18*. bimum*
Dioicous 17

17 { Ls. narrowly bordered ; capsule constricted below mouth when dry *16. turbinatum*
Ls. widely bordered ; capsule not markedly constricted *18. pseudo-triquetrum*

18 { Autoicous ; lower leaves reddish ..... *18*. pallescens*
Synoicous 19
Dioicous 21

19 { Ls. spirally twisted when dry ..... *22. capillare* var. *β*
Ls. scarcely twisted when dry 20

20 { Ls. serrulate at point ; capsule usually incurved ; lid small *19. intermedium*
Ls. almost entire at point ; capsule regular ; lid larger ..... *18*. affine*

21 { Ls. usually obovate, much twisted when dry ..... *22. capillare*
Ls. more tapering, not or rarely twisted 22

22 { Ls. narrowly acuminate 23
Ls. wider, border distinct ..... *22*. obconicum*

23 { Border faint or absent ..... *20. caespiticium*
Border strong ..... *22*. rufifolium*

[The species of this Section naturally form three or four fairly clearly marked groups, which may be classed under two distinct Subsections ; (I) those with the leaves *usually narrowly and sharply acuminate*, having the nerve excurrent *in a long cuspidate point or arista*, the leaves themselves usually moderately large and the plants more or less robust, the capsules brown, large and long, *rarely under 1½ lines in length* and usually 2 lines, or more ; (II) plants often small and slender, with small leaves, *rarely acuminate, the nerve vanishing at or below apex*, or excurrent in a *short* point only ; capsules often deep red, small, *short, rarely over 1½ lines long*, often less.

These two groups are fairly natural, and there will be no difficulty as a rule in determining to which of them a given plant belongs, although the characters above defined do not all hold good in every species. It may be borne in mind that all the species with longly excurrent nerve, and all those with long capsules (2 lines or more) fall within (I) ; and that the only species in that group which have the leaves obtuse (*B. neodamense*), or very shortly pointed (*B. bimum* and *B. pseudo-triquetrum*), are at once referable to it from their robust habit and long capsules. The spores in Eu-Bryum are usually small, mostly under 15 *μ*, less frequently up to 20 *μ*, very rarely more.]

(SUB-SECTION I.)

17. Bryum neodamense Itzigs. (Tab. XLIV. A.).

Tall, *slender*, brownish green, slightly branched ; leaves *very distant*, except at the summit of the stem, where they form a

close coma, slightly and narrowly decurrent, *broadly oval from a narrow* base, *very concave, obtuse*, except occasionally in the comal leaves; entire, margin erect, *plane, or very slightly recurved below;* nerve *vanishing below the summit*, rarely in the comal leaves reaching apex or very shortly excurrent; cells a little wider than in the following species, the marginal forming a distinct border. Capsule rather shorter than in that, obovate-pyriform, neck shorter than the capsule itself, lid shortly apiculate. *Dioicous;* male flower as in *B. pseudo-triquetrum.*

HAB. Ditches by the sea.; Southport; Sands of Barrie. Fruit very rare, summer.

This species is quite distinct in its tall stems with lax, very rounded, concave, almost cochleariform, obtuse leaves, which, however, in the comal tuft show some approach to the more usual Bryoid outline. In the almost plane margin of the leaves, as well as in their form, it appears to be very distinct from *B. pseudo-triquetrum.* The fruit has only once been found in Britain.

18. Bryum pseudo-triquetrum Schwaeg. (*Mnium pseudo-triquetrum* Hedw.; *B. ventricosum* Dicks., Braithw. Br. M. Fl.; *B. intortulum* Stirt. in Trans. Bot. Soc. Edin. xxvi, 428) (Tab. XLIII. H.).

Robust, tall, 2–6 inches high, deep green to purplish, stems stout, rigid, loosely or more frequently densely tufted, usually interwoven with brown tomentum. Upper leaves forming a large comal tuft, long, 1–1½ lines or more, erecto-patent or spreading, straight, when dry usually somewhat shrunken, *twisted and appressed, oblong-lanceolate or lanceolate*, tapering to a *short point*, from a wide, often slightly expanded red base; margin slightly recurved nearly to the summit, slightly denticulate at apex or entire; nerve strong, reddish, reaching apex and usually *shortly excurrent* in a denticulate, cuspidate point; cells rather smaller than in most of the previous species, rhomboid-hexagonal, narrower towards the margin, 3–4 rows very narrow, forming a distinct, often yellowish border. Seta *long*, 1–2½ inches, curved or bent at the top, so that the capsule is inclined or sub-pendulous; capsule *long* (2–2½ lines), *large*, bright or dark brown, clavate or sub-cylindric with a long tapering neck often nearly as long; frequently inflated below and curved upwards, lid large, conical, acuminate; peristome large. Spores 14–20 μ. *Dioicous.* Male flower large, terminal, sub-discoid.

Var. β. *compactum* B. & S. *Shorter and more compact:* leaves more crowded; seta *shorter;* capsule *shorter and wider.*

HAB. Bogs and wet places; frequent in mountainous districts; the var. β rare. Fr. summer.

A fine species, not likely to be confounded with any other except *B. bimum*, on account of the robust habit, the large leaves with short points, and large, long capsule on a tall seta. It varies much in habit and size, being occasionally found with exactly the habit of *B. bimum*, but usually more robust and compact, with darker coloured, more solid leaves, less shrunken when dry.

The var. *compactum*, when growing on drier heaths, occasionally becomes very small indeed, with a reddish tinge, so that it may even be taken for *B. erythrocarpum*, the cells and margin of which are, however, quite different. In this condition it is generally sterile. Although variable, this species is less so with us than on the continent, where it assumes an almost endless variety of forms.

*** Bryum bimum** Schreb. (Tab. XLIV. B.).

Differs from *B. pseudo-triquetrum* essentially in the *synoicous inflorescence*. It is usually also, but not constantly, a *softer, laxer plant with paler, more flaccid leaves, more shrinking when dry;* the capsule a little less swollen and more symmetrical; but none of these characters are constant.

HAB. Bogs and pools; not uncommon. Fr. summer.

After much hesitation I have thought it right to unite this plant and *B. pseudo-triquetrum*, being convinced that, beyond the inflorescence, there is no real difference between the plants. The pale, lax-leaved, more flaccid plants certainly as a rule belong to *B. bimum*, but this is not invariably the case; and on the other hand, *B. bimum* is undoubtedly often fully as rigid and compact, and with the leaves of exactly the same form, while the same variations of capsule are found in the one as in the other. I have found the two plants growing together luxuriantly and betraying no marked differences of any kind except in the inflorescence. The leaves are usually concave, in some forms very markedly so.

*** Bryum affine** Lindb. (*Webera affinis* Bruch; *Bryum cuspidatum* Schp., Syn.) (Tab. XLIV. C.).

Closely resembles *B. pallescens*, hardly differing except in the inflorescence, which is *synoicous*. The leaves are slightly decurrent, the apex and excurrent nerve scarcely toothed, the capsule rather more pendulous, and perhaps as a rule rather shorter.

Var. *β. cirratum* Braithw. (*Bryum cirratum* Hornsch., Schp. Syn.). Leaves *longer, more longly acuminate*, with a wider border; nerve *longly excurrent* in a denticulate arista; capsule short.

HAB. Walls, rocks, etc., in damp places, not common. The var. *cirratum* at higher altitudes. Fr. summer.

Most of the characters given above are inconstant, especially when account is taken of the var. *cirratum*. In fact, the five plants *pseudo-triquetrum, bimum, affine, cirratum*, and *pallescens* form a closely united group,

in which the inflorescence is, perhaps, the most stable character, and even that is not constant. Mr. Nicholson has sent me two plants from Sussex, which, with the characters of *B. affine*, have occasionally flowers which are male only, and Warnstorf describes a *B. bimum* var. *amoenum* with some female flowers. Hagen has also recently described two varieties of *B. pallescens* with similarly heteroicous inflorescence, while Schiffner describes a var. *synoicum* with most of the flowers synoicous, some being male only.

The relationships seem to me on the whole best preserved by grouping both *B. affine* and *B. pallescens* with *B. bimum*.

The var. *cirratum* is the alpine form of *B. affine*.

*** Bryum pallescens** Schleich. (Tab. XLIV. D.).

Usually in dense tufts, stems mostly short, ½–2 inches, with slender innovations; yellowish green, tomentose below. Upper leaves forming a comal tuft, *ovate, or ovate-lanceolate, acuminate*, hardly decurrent, rather small, slightly twisted when dry, margin narrowly recurved, nerve excurrent in a *rather long, toothed, cuspidate point;* cells rather small, narrow at margin, *forming a yellowish border*. Seta about 1 inch long, capsule sub-horizontal or inclined, *oblong-pyriform*, 1½ lines long, with a tapering neck shorter than the sporangium, *symmetrical*, slightly contracted below the mouth, pale brown; lid convex, apiculate. *Autoicous;* male flower on a separate branch.

HAB. Rocks, walls, etc., usually in mountainous regions, not common.

B. pallescens differs but little, as pointed out above, from *B. affine*. It resembles a small form of *Bryum bimum*, and also *B. intermedium* and *B. caespiticium*, but differs in the autoicous inflorescence; from the first of these it differs, too, in the more acuminate leaves with longer points, and from the other two in the more distinct border to the leaves. It is for the most part an inhabitant of sub-alpine regions, and is somewhat variable in size.

19. Bryum intermedium Brid. (Tab. XLIV. G.).

In dense tufts, deep green, stems short with short innovations, about ½–1 inch high. Leaves crowded, when dry imbricated, hardly twisted, concave, ovate-lanceolate and oblong-lanceolate, acuminate, margin revolute, almost entire, nerve excurrent in a rather long entire or denticulate point; cells much as in *B. pallescens*, but with the marginal ones *hardly forming a distinct border*, although narrower and longer than the median ones. Capsule brown, 1½ lines long, *sub-pendulous, shortly clavate or narrowly elliptic-pyriform, often a little gibbous on the back and incurved*, neck rather quickly passsing into the seta, mouth *small*, lid conical, obtuse or acuminate, *persistent;* peristome small, pale, the teeth incurved when dry. Spores 20-25 μ. *Synoicous*.

HAB. Wet ground and damp shady walls. Common. Fr. summer and autumn.

The leaves of this moss much resemble those of *B. caespiticium* and other allied species, but it fruits abundantly, and may be recognised without great difficulty by the synoicous inflorescence and the form of the capsule, which is more pendulous than in *B. caespiticium*, *B. affine*, and *B. pallescens*, not recurved, but incurved when asymmetrical, and with a distinctly smaller mouth, less conspicuous peristome, and larger spores. The lid also is much more persistent, often remaining in its place for months after the capsule is matured. The time of fruiting is also a distinguishing character, the capsules not ripening until considerably later than in the allied species, and then being produced in succession for several months, so that they may be found in various stages of maturity in a single tuft. The leaves also want the defined border characteristic of most of the species, but the marginal cells are distinctly narrower, and as the leaf-margin is usually strongly recurved it is not always very easy to verify this character. It prefers moister situations than *B. caespiticium*.

20. Bryum caespiticium L. (Tab. XLIV. E.).

Densely tufted, about 1 inch high, pale bright silky green; stems slender, often with very slender innovations. Leaves rather small, uppermost forming a crowded coma, oblong-lanceolate, usually wider below the middle, *narrowly acuminate, imbricated and hardly twisted when dry*, margin revolute to near the summit, almost entire, nerve excurrent in *a long arista;* cells rather firm and narrow, the marginal ones very narrow, but usually hardly forming a distinct border, especially at the apex. Capsule oblong-pyriform or clavate, 1½ lines long or slightly longer, *frequently gibbous below and recurved upwards* from the neck, brown, *wide-mouthed, horizontal or inclined*, sometimes inflated with a smaller mouth, lid orange, mamillate or conical and apiculate, *not persistent;* peristome large, rather pale. Spores 10–14 μ. *Dioicous.*

Var. β. *imbricatum* B. & S. (var. *Kunzei* Braithw., Br. M. Fl.; *B. Kunzei* Hornsch.). *Very compact;* leaves sub-equal, imbricated so as to render the branches *julaceous, very concave, ovate-oblong, more suddenly acuminate.*

Var. γ. *badium* Brid. (*B. badium* Bruch, Schp. Syn.). More *slender;* bright green or reddish; leaves *narrower*, more acuminate; capsule *shorter, obovate*, less tapering at neck, *dark brown.*

HAB. Dry banks, rocks and walls. Common. The var. β rare; the var. γ, Milnthorpe, Westmorland (*Barnes*); Arncliffe Wood, Yorkshire (*Ingham*). Fr. summer.

A common and rather variable species; when fertile the capsules are produced abundantly. They are somewhat variable in form and usually more or less gibbous below, nearly horizontal when dry, and wide-mouthed; by which characters and by the dioicous inflorescence the species may be known from *B. intermedium*. *B. capillare* is known by the very different leaves, *B. inclinatum* —usually a more robust plant— and *B. pendulum* by the peristome, spores, and distinctly bordered leaves, *B. affine* by the synoicous

inflorescence, and *B. pallescens* by the autoicous inflorescence and more distinctly bordered leaves with wider cells. It is this last species with which, perhaps, the greatest difficulty is likely to arise.

The absence of a border to the leaves cannot, I fear, be relied upon as a thoroughly constant and satisfactory character, as forms undoubtedly occur in which this structure is decidedly manifest.

The Rev. W. E. Thompson sends a plant with marked varietal characters, from Hunstanton, Norfolk; the spores are much larger, reaching fully 25 μ; the peristome, especially the inner, is of a deeper, orange colour, and there are other characters of some importance. It may probably prove worthy of varietal rank, unless, as I think not improbable, it is the result of a cross between *B. pendulum* and the present species.

21. Bryum provinciale Philib. (*Bryum canariense* Schp., nonnull. auct., *non* Brid.) (Tab. XLIV. F.),

Resembling *B. inclinatum*. Stems robust, 1 inch high, in large, dark olive green tufts; leaves *interruptedly tufted*, the terminal of each year forming a large rosette, those of the intermediate parts of the stem much smaller; upper leaves closely imbricated and straight when dry, forming a rigid, cuspidate tuft; when moist *very concave*: large, *obovate or widely ovate-spathulate*, *sub-acute*, *not acuminate*, margin strongly recurved to near but not quite to apex, above *strongly toothed*, nerve strong, red or yellowish, excurrent in a rigid, straight or somewhat reflexed cuspidate point; cells incrassate, especially above, regularly hexagonal-rhomboid, *remaining wide to near the margin and apex*, one or two rows only at margin slightly narrower. Capsule pendulous, on a red seta cygneous at the summit, oblong-cylindric with a long tapering neck, dark brownish red, large, 1½–2 lines long, lid conical, acuminate or apiculate: peristome large, yellowish. Autoicous and synoicous, often on the same plant.

Hab. Dry hills, often in woods, chiefly in the south, rare. Fr. summer.

Although resembling in habit some forms of *B. inclinatum*, this plant is perhaps more allied to *B. capillare*, from which however it is easily known by the firmer, very concave, more serrate leaves with rigid points, not spirally twisted when dry, and arranged in conspicuous, interrupted tufts. This latter feature occurs at times in *B. inclinatum*, but there is no great difficulty in distinguishing *B. provinciale* from it, as well as from all the species with similar leaves, if the following points be kept in mind. In *B. inclinatum* the leaves at the apex are narrowly acuminate, indistinctly toothed, and with the cells all becoming narrower, especially towards the margin, those at the edge being extremely narrow and elongated; in *B. provinciale* the apex is wide, rarely at all acuminate, with distinct and spreading serratures for some way down the leaf, and with the marginal and indeed all the cells hardly altered towards the apex, only a single row or at most two at the very margin being slightly narrower than the rest. The very concave leaves with strongly recurved margin are also characteristic. The capsule resembles that of *B. capillare*.

B. provinciale appears to prefer calcareous soil, but is certainly not confined to it.

22. Bryum capillare L. (Tab. XLIV. H.).

Loosely or densely tufted, deep green, reddish below, soft, ½--2 inches high, with numerous branches. Stem in section with a *small* central-strand, about 25 μ across. Leaves loosely or densely set, the comal not very distinct, when dry *usually strongly spirally twisted round the stem*, with the points flexuose ; sometimes, especially in the laxer forms, not spirally twisted, but variously spreading or incumbent ; *soft in texture, much shrinking when dry ; wide, obovate-spathulate*, variable in length, plane or concave, shortly acuminate and *rather suddenly cuspidate or piliferous with the longly excurrent often reflexed nerve*, which is broad below ; margin entire or finely toothed, variously recurved ; cells rhomboid-hexagonal, short and rather wide, thin-walled, the marginal in several rows usually very narrow, forming a distinct, but not thickened border. Seta long, capsule *large*, long (about 2 lines), sub-cylindrical with a distinct neck of almost equal length, horizontal or inclined, hardly contracted below the wide mouth when dry, symmetrical or rarely slightly curved, bright brown or deep brownish red, the mouth deep red and glossy, lid *orange-red*, conical-apiculate ; peristome large, reddish at base, pale above. *Dioicous ;* rarely autoicous ; the var. β synoicous.

Var. β. *torquescens* Husn. (*B. torquescens* B. & S., plur. auct.). Inflorescence *synoicous*. Capsule *deep reddish brown*.

Var. γ. *macrocarpum* Huebn. *Robust*, densely tufted ; capsule *large, long, deeper in colour*.

Var. δ. *rosulatum* Mitt. *Very short*. Leaves *crowded in terminal rosettes*, quite entire, often twisted and recurved at apex, nerve *vanishing considerably below the summit*, leaf-border narrow.

Var. ϵ. *flaccidum* B. & S. Stems short with slender branches. Leaves *soft, narrow*, spreading, *shrinking when dry but not appressed nor spirally twisted, distant*, more distinctly toothed.

Var. ζ. *elegans* Braithw. (*B. elegans* Nees ; *B. barbatum* Wils. ; *B. Stirtoni* Schp., Syn. ; *B. leptaleum* Stirt. in Ann. Scot. Nat. Hist. xii, 113). Densely tufted, bright or dull green ; leaves *regularly imbricated, julaceous, very concave*, cymbiform, rounded-obovate, nerve often excurrent in an *abrupt*, flexuose, sub-piliform point, sometimes ceasing below apex ; leaves *scarcely twisted when dry*. Border present or absent. Capsule smaller.

HAB. Walls, rocks, tree trunks, etc. Abundant. The var. *torquescens* rare, chiefly in the south ; var. *macrocarpum* a common form on walls in moist sub-alpine districts ; var. *rosulatum*, Sussex (*Mitten*) ; var. *flaccidum* rare, in moist, sheltered situations ; var. *elegans* rare. Fr. summer.

One of the most abundant and variable species of the genus ; the above varieties do not, by far, exhaust the various forms, but they appear to be the most strongly marked British ones. The synoicous inflorescence appears

to be the only reliable character by which to distinguish the var. *torquescens*; and even this is, according to the observations of reliable authorities, subject to variation, both synoicous and dioicous flowers being found on the same specimen. The somewhat different distribution is the only other character that can be claimed for it,—the deep red capsule being equally characteristic of dioicous plants—and this, even were it more pronounced than it actually is, could not be allowed to constitute specific rank in the absence of other characters.

B. capillare is usually recognised without difficulty by the soft leaves, wide in the upper part, very generally spirally twisted when dry, with short, chlorophyllose cells, the chlorophyll grains being very beautifully and distinctly defined even after drying.

Although in its marked forms a very strikingly distinct plant, I can scarcely look upon *B. elegans* Nees as more than a variety of *B. capillare*, of which it has the leaf structure, although the form and arrangement of the leaves are so distinct. In the looser parts of the tufts too they often lose much of their distinctive character, and forms occur with the leaves spirally twisted when dry. The var. *Ferchelii* B. & S. must be included in this variety, of which it is a more slender and smaller form in all its parts, usually with shorter points to the leaves. *B. barbatum* Wils. and *B. Stirtoni* Schp. must I think without doubt be looked upon as forms of the var. *elegans*.

* **Bryum obconicum** Hornsch. (*B. capillare* var. *obconicum* Huebn., Braithw. Br. M. Fl.) (Tab. XLV. A.).

Differs from *Bryum capillare* in the shorter, dense tufts, the leaves *less spathulate, rather ovate or ovate-oblong, more acuminate, not twisted when dry, but appressed and incumbent;* capsule rather smaller, with a somewhat longer more tapering neck.

Hab. Dry heaths and rocks. Not common. Fr. summer.

The practice of modern authors, to unite this plant with *B. capillare*, is doubtless the right one. There is very little difference in the form of capsule, and that of the leaves is very little greater than in some of the above varieties; they are usually rather smaller, and being closely appressed and straight when dry, they give a very different look to the plant. Forms occur, however, quite intermediate between this and *B. capillare*, some with the leaf outline of *B. obconicum*, but more or less spirally twisted, others with the leaves intermediate in form. The capsules, as often occurs in this genus, are variable in size even within the limits of a single tuft.

B. obconicum is easily recognised from *B. caespiticium* and *B. intermedium*, by the broader leaves and almost or quite symmetrical, larger capsules.

* **Bryum rufifolium** Dixon nom. nov. (*Bryum rubicundum* Stirton in Trans. Bot. Soc. Edinb. xxvi, 246.). (Tab. LXII. C.).

In very dense, *deep red or variegated, compact* tufts. Leaves still narrower than in *B. obconicum*, usually *very narrowly and longly acuminate*, nerve excurrent in a *long, glossy arista*, usually about half the length, but occasionally equalling the length of the leaf. Leaves when dry shrunken and contorted, rarely spirally twisted. Border *extremely wide*, of strongly incrassate cells. Fruit unknown.

HAB. Plockton, Ross-shire (*Stirton*); Llangollen, N. Wales (*Barker*).

The original gathering is a very beautiful plant, and in its extreme forms very distinct; but the presence of stems here and there having the leaves spirally twisted when dry, together with the variability of the leaf form, sometimes differing little from *B. obconicum*, indicate its close affinity to *B. capillare*. Prof. Barker's plant moreover, with the same habit and leaf character, is without the special colouring, and is less extreme in other respects.

Stirton's name cannot stand, being antedated by *B. rubicundum* C.M., an African species, published in 1859. I have therefore re-named it, keeping as nearly as possible to the significance of Stirton's name, although, as remarked above, the colour is not a constant character.

23. Bryum Donianum Grev. (Tab. XLV. B.).

Shorter than *B. capillare*. Stem in section with a *very wide* central stand; leaves more densely crowded in short comal tufts, *twisted when dry but hardly spirally contorted, ovate-oblong*, somewhat acuminate, *nerve strong, excurrent in a very short point*, border yellow, of several rows of cells, *thickened;* areolation firmer, margin more distinctly and regularly toothed. Capsule resembling that of *B. capillare*, especially the var. *torquescens*, usually somewhat curved. Dioicous.

HAB. Stony ground and gravelly banks; not common. Fr. summer.

Much resembling *B. capillare*, but known by the characters italicised; the thickened border especially is characteristic; and the same remark applies to this structure as was made under *B. pallens*. It is generally of a more reddish tinge, the leaves somewhat more rigid and solid, the excurrent nerve shorter and more rigid. It is a southern species.

(SUB-SECTION II.)

24. Bryum erythrocarpum Schwaeg. (*B. sanguineum* Brid.) (Tab. XLV. C.).

In short, loose tufts, often with a tinge of red; stems slender, often bearing at the base globose multicellular crimson translucent *gemmae*. Leaves crowded or distant, rather rigid, erect when dry, not forming comal tufts, *small, narrowly ovate-lanceolate or lanceolate*, margin variously revolute, denticulate above; nerve reddish, *vanishing at apex or excurrent in a short mucro*, rarely in a longer, denticulate, cuspidate point; cells *longly hexagonal-rhomboid*, marginal in one or two rows narrower, but rarely forming a distinct border. Seta slender, *dark purple red*, rather flexuose, *1–1¼ inches long*, variously hooked above; capsule sub-pendulous, about 1½ lines long, *narrowly oblong-pyriform*

with a slender tapering neck, slightly incurved, *bright crimson or purplish*, rather wide-mouthed after the fall of the lid, which is bright shining crimson, conical-acuminate; peristome rather large, reddish. Dioicous.

HAB. Sandy and peaty heaths, etc. Common. Fr. summer.

A beautiful species when in good fruit, but very frequently found sterile only, when the stems and branches are more elongated. The red radicular gemmae, which are very conspicuous, are characteristic of this and the allied *B. rubens*, and as in barren plants they usually occur abundantly, they form a useful feature for identifying these plants; in addition to which the leaf is distinct in form and structure. The difficulty probably lies principally in separating the various species of the group. *B. atropurpureum* differs in the shorter capsule with abruptly ending neck, *B. murale* in the narrower cells, obtuse lid and wider, larger capsule. It is doubtful whether any differences between *B. atropurpureum* and *B. erythrocarpum* founded on the leaves, are constant; these however in the present plant are usually longer and narrower, with the nerve more decidedly excurrent.

Mr. Nicholson has gathered a remarkable plant at Crowborough, Sussex, differing very conspicuously from the type of *B. erythrocarpum* in the wide fruit, tapering to a very short neck, and in this respect coming near *B. atropurpureum*; the other characters are however rather those of the present species, but the lid is paler, the peristome teeth yellowish, not reddish, the basal cells much laxer. It has been variously referred to several rare continental species, but Dr. Hagen's opinion is that it can scarcely be separated from *B. erythrocarpum*, under which however it must probably receive the rank of a variety. It differs from *B. atropurpureum* markedly in the radicular gemmae, the longer seta, and the tapering though very short neck.

[An allied continental species, *B. Sauteri* B. & S., is included by Hobkirk in his Synopsis of British Mosses, the localities given being Teesdale (*Spruce*) and Scotland (*Mitten*). No confirmation however of these records has been found (cf. Journ. of Bot., Sept., 1923), and they appear to be unfounded.]

*** Bryum rubens** Mitt. (Tab. XLV. D.).

In *straggling, loose tufts*, nearly allied to *B. erythrocarpum*. Leaves with the marginal cells narrow and elongated in 2-3 rows, *forming a distinct, often coloured border*; cells *larger*. Capsule *often paler and less brightly coloured*, the neck a little less tapering and slender; lid large, acutely acuminate.

HAB. Sandy ground, very rare. Fr. summer.

The presence of a distinct border in this plant is of less value as a specific character than at first appears, inasmuch as traces, at times very distinct, of the same structure may be seen in *B. erythrocarpum*. There is, however, in addition to this, a peculiar habit belonging to *B. rubens*, due to the untidy straggling growth. The cells also seem to be distinctly larger than in *B. erythrocarpum*. The radicular gemmae are present as in that species. The fruiting characters given in Ed. I appear to be mostly unreliable.

25. Bryum atropurpureum W. & M. (*B. bicolor* Dicks., Braithw. Br. M. Fl.) (Tab. XLV. E.).

In close tufts, resembling *B. erythrocarpum*, but usually shorter and more compact; without radicular bulbils; leaves a

little wider, but not constantly so; nerve *rather less excurrent, sometimes vanishing*. Seta *short, less than one inch in height*, arcuate above, dark purple red; capsule pendulous or nearly so, *small, thick, and short*, less than one line in length, *shortly oblong or obovate, with an indistinct neck abruptly passing into the seta, deep purple-red*, slightly contracted at the mouth, lid bright red, shining, wide, conical, shortly apiculate. Dioicous.

Var. β. *gracilentum* Tayl. (*B. elegantulum* Stirt. in Scot. Bot. Rev. i, 92) *Taller and more slender;* leaves broader, the nerve often vanishing below apex. Bulbiform *gemmae* are borne *in the axils of the upper leaves*.

HAB. Clay banks, roadsides, etc. Common. The var. β with the type, frequent. Fr. early summer.

Easily recognised by its bright red fruit, which differs from that of the allied species in the abruptly ending neck, not tapering into the seta, and in its generally short, thick outline; it is not unlike that of *B. argenteum*, with which it often grows, but the vegetative part is quite different. When barren it is with difficulty separated from the preceding species; indeed it is not safe to attempt to separate barren plants except in the case of well-marked forms. The leaves however are usually closer and less elongated, the habit less straggling; while the globose basal gemmae appear to be absent here; axillary bud-like gemmae sometimes occur, but not commonly in the type. The var. β is often very small and slender, the leaves often obtuse in outline, variable and indeed deformed.

Bryum Barnesii Wood (*Schp. Syn.*) appears, in part at least, to belong here. I have only seen a single stem, labelled as collected by Barnes, and the areolation, both upper and lower, agrees very nearly with some forms of the present species, scarcely with *B. argenteum*, to which Braithwaite refers it; the cells being exactly rhomboid-hexagonal with very thin walls, while *B. argenteum* has the cells more or less distinctly incrassate; nor is there anything in the habit or leaf form to recall that species. Possibly more than one plant was included in his gatherings, and in any case the specimens appear to represent one of those undeveloped, somewhat abnormal barren forms not uncommon in this genus, and often impossible of identification.

26. Bryum murale Wils. (Tab. XLV. F.).

Resembling *B. erythrocarpum*, but in more *dense, compact* cushions; the leaves crowded in terminal tufts, more rigid, wider at the base, *oblong, acuminate*, margin narrowly reflexed, nerve thick, *excurrent in a cuspidate point;* cells *distinctly narrower* than in the two preceding species, *narrowly linear-rhomboid*, rectangular at base. Seta $\frac{3}{4}$–*1* inch long, arcuate or hooked above, capsule sub-pendulous or inclined, finally often horizontal, *larger than in B. erythrocarpum*, $1\frac{1}{2}$ lines long, *wider, oblong-pyriform or widely pyriform*, neck *shorter and much less tapering; bright red*, sometimes contracted at the mouth, persistent; lid *large*, obtuse or scarcely apiculate, shining. Dioicous.

HAB. On mortar of walls; not common. Fr. early summer.

In the form of fruit this species is somewhat intermediate between *B. erythrocarpum* and *B. atropurpureum*, being less tapering in the neck than the former and more so than in the latter; but it is larger than either, with a more elevated lid; the narrow cells form a good and easily observed character by which even barren plants may be known. The old black capsules of the previous year may usually be found on the same tuft with the ripening ones. *B. murale* appears to prefer the mortar of *new* walls, and sometimes disappears suddenly from spots where it has been very abundant. Like *B. caespiticium*, it sometimes has the capsules small-mouthed and inflated or widely pyriform. I have found it in very fine fruit, but with this condition of capsule very marked; and in Wilson's Herbarium there is a drawing of the same form, labelled "*forma microstoma*," from Bangor; it has then a very different appearance from the typical form, but as the fruit ripens the distinctiveness diminishes. It is possible that it is in some degree a pathological condition.

These three species, *B. erythrocarpum*, *B. atropurpureum*, and *B. murale*, form a distinct and natural group, characterised by their blood-red capsules and small leaves of a fairly uniform type, acuminate with the nerve shortly excurrent and with small, rather narrow cells. *B. murale* forms a somewhat intermediate link with the next group in areolation and leaf-outline, but differs widely in the acuminate, acute leaves and cuspidate nerve point.

27. **Bryum alpinum** Huds. (Tab. XLV. G.).

In dense, wide tufts, *rigid, robust*, 1–3 inches high, usually of a *deep glossy crimson*, or variegated with red and green, with few branches. Leaves usually sub-equal, erecto-patent, when dry not much shrinking nor twisted, *straight and closely imbricated*, and very glossy, *narrowly oblong-lanceolate, obtuse or acute*, not or rarely acuminate, decurrent, *concave*, margin reflexed, entire or faintly denticulate at apex, nerve thick, *vanishing below or reaching apex*, rarely slightly excurrent, purple, cells *narrowly linear-rhomboid*, usually, in the older leaves especially, narrowly linear and incrassate, narrower still towards margin but not forming a distinct border. Seta flexuose, about 1 inch high, capsule variable, 1–1½ lines long, pendulous or inclined, *deep red, pyriform*, with a tapering neck, small-mouthed, persistent; lid glossy, mamillate. Peristome reddish. Dioicous.

Var. β. *viride* Husn. *More slender*, leaves *less closely imbricated*, often wider, *pale green or very slightly tinged with red*, more acute; cells *a little wider*, less incrassate.

Var. γ. *distantifolium* Dixon, *Handb. Ed. I.* Tall, *robust, green above*, pale yellowish brown below. Leaves *large*, long, *distant, divergent*, tapering, rather more loosely areolate.

Var. δ. *meridionale* Schp. Leaves more rigid, narrower, the upper *very narrowly oblong-lanceolate*, cells *narrower, longer*.

Hab. Wet alpine and sub-alpine rocks; rarely on less elevated heaths; common, except in the lowlands. The var. β at low altitudes, not common. The var. γ on stones in a mountain stream, Honister Pass, Cumberland, 1895 (*Dixon*). The var. δ, Cornwall, Yorkshire. Fr. rather rare, summer.

One of the most beautiful of our mosses, with a splendid almost metallic lustre and rich colouring. The var. *viride* is in its extreme form a very distinct and different looking plant, resembling *B. Mildeanum* very closely; intermediate forms between it and the type may, however, often be found. *B. alpinum* is the type of another well defined group, including also *B. gemmiparum*, *B. Muehlenbeckii*, and *B. Mildeanum*, known by their deep red capsules, the leaves erect and imbricated when dry and little altered, more or less oval-oblong, obtuse or slightly acute, hardly acuminate, with the nerve vanishing or at most shortly mucronate, and the cells frequently very narrow. It can hardly be confused with any species except the ones in question; of these *B. Muehlenbeckii* differs in the obtuse, cucullate, widely areolate leaves, *B. gemmiparum* in the shorter stems, wider, less pointed, less rigid leaves with rather wider cells, and *B. Mildeanum*, as pointed out under that species, in the colour, the more excurrent nerve, wider cells, and other points.

The var. *distantifolium* is a marked form, well deserving of notice; the leaves are much more distant than in any form I have seen of this species, not imbricated, spreading or divergent, longer and larger than in the type, and of the same colouring as in the var. *viride*.

28. Bryum gemmiparum De Not. (Tab. XLV. H.).

Resembling *B. alpinum*, but *paler*, in *shorter, stunted tufts; the young shoots bright green*, the older reddish. Leaves *wider, ovate, shortly and widely, almost obtusely pointed, not* glossy, nerve vanishing below apex or just reaching it; cells *wider*, narrowly hexagonal-rhomboid, thin-walled, narrower at margin, which is *slightly reflexed below;* nerve thinner. Gemmae frequently occur among the upper leaves. Capsule oblong-pyriform, reddish. Dioicous.

HAB. Rocks in and by water; R. Usk, Monmouth; and R. Grwyne, Brecon. Both sterile. Fr. spring.

A Mediterranean species, intermediate between *B. alpinum* and *B. Muehlenbeckii;* the leaves wider and more obtuse than in the former, with wider cells; less obtuse and cucullate than in the latter, and with narrower areolation. It is also of a paler colour than either. It is probable that it should be ranked as a sub-species of one or the other.

29. Bryum Muehlenbeckii B. &. S. (Tab. XLV. I.).

Resembling *B. alpinum* but *more slender*, scarcely glossy, rather less brightly coloured, olive green, tinged with deep red. Leaves *wider, ovate and elliptic, with the apex obtuse or obtusely apiculate, strongly incurved and cucullate*, nerve *stout, vanishing in the apex;* cells *widely hexagonal, much laxer than in B. alpinum.* Capsule oblong-pyriform, small, reddish, brown. Dioicous.

HAB. Wet places in mountains, very rare. Fr. late summer.

A very distinct species, not found in fruit in this country; but well distinguished by its superficial resemblance to *B. alpinum*, but with broad, obtuse, cucullate leaves with much looser areolation.

When growing in mountain streams it sometimes simulates a short purplish form of *B. pseudo-triquetrum*, but the similarity disappears entirely when dry, owing to the twisting and shrinking of the leaves in the latter.

30. **Bryum Mildeanum** Jur. (Tab. XLV. J.).

Resembling *Bryum alpinum* var. *viride*. Tufts swollen, *soft, pale green*, bright or shining, brown or red in the interior; stems *slender, red below*, 1–2 inches high. Leaves sub-equal, *very concave*, lower *widely oval-acuminate*, upper narrower, *elliptic-oblong, gradually acute or slightly acuminate*, erecto-patent, *less crowded than in the above-mentioned plant and smaller*, erect and appressed when dry; margin widely reflexed or revolute, plane at apex, entire or obsoletely denticulate at point, nerve strong, red in the older leaves, yellowish in the upper, *excurrent in a stout straight mucro*. Areolation *much wider than in typical B. alpinum*, and distinctly wider than in the var. *viride*, especially in the lower leaves; *hexagonal-rhomboid, thin-walled*. Capsule purple-red, clavate-pyriform. Dioicous.

HAB. On rocks and in sand in and near monutain streams; rare. Fruit very rare, not found in Britain, ripening in late summer.

This plant comes very near to the green, laxer-leaved form of *B. alpinum*, and it is quite possible that it may eventually have to be classed as a sub-species of that plant. I have however found the two growing closely intermixed, almost indistinguishable even with the lens, yet under the microscope retaining their characters constantly. *B. alpinum* almost always shows some slight trace of vinous red on the nerve and margin at least of some (even among the upper ones) of the leaves, which are all of nearly equal width; and in the var. *viride* the lower part of the stem, as well as the older leaves, is rather brown than red, and the nerve either vanishes below the apex or is barely excurrent. In *B. Mildeanum*, on the other hand, the upper leaves never show any trace of red, and are usually of a brilliant green, rarely if ever found in the other species; while the lower leaves and the lower part of the stem are often bright brownish red, though not constantly so; the lower leaves, also, are almost always distinctly wider than the upper, with more acuminate points and laxer areolation, the latter being constantly wider, or at least as wide as in the most laxly areolated leaves of the allied plant; and the nerve is always excurrent, usually in a distinct, rigid mucro, which is longest in the lower leaves. It will be seen from this that the lower leaves form the safest guide to the identity of the species, except as regards colour.

Considerable variation occurs in the slenderness of the stems, but in other respects it is fairly constant in character; our British plant appears to be usually more robust than the continental one; I have gathered it in numerous localities in England, Scotland, and Wales, always taller and stronger than is usual on the continent, judging from specimens and descriptions. With the exception of the green forms of *Bryum alpinum*, I have found no difficulty in recognising it at once in the field from any of our other species, by the brilliant green tufts with concave, shortly pointed leaves. The margin is often described and figured as strongly revolute, but I have usually found it only slightly, though widely reflexed, so that viewed under the microscope it has somewhat the appearance of the flat edge of a dish or platter.

B. gemmiparum differs in the more densely imbricated leaves, which are rather more obtuse, with the nerve scarcely excurrent, and the margin less widely and less strongly reflexed. *B. caespiticium* resembles it, but is known by the more tapering leaves with long points.

31. Bryum Dixoni Card. *ex Nicholson in Rev. Bry. 1901, p. 73* (Tab. XLV. K.).

In *dense compact tufts, scarcely half-an inch high, yellowish green*, glossy, *golden yellow when dry*, dark brown below. Stems slender, filiform, *fragile*, branched. Leaves crowded, erecto-patent, when dry appressed and closely imbricated, not much altered, not twisted, *very small*, less than 1 mm. in length, *very widely ovate, not or scarcely acuminate, very shortly pointed, concave*, slightly decurrent; margin *plane*, entire or denticulate at apex; nerve strong, yellow, very wide at base, *ceasing at apex or excurrent in an exceedingly short mucro*. Upper cells somewhat incrassate, small, rhomboid, a few rows at margin narrower, but *not forming a distinct border*, basal cells larger, rectangular, towards angles quadrate, becoming reddish. Inflorescence and fruit unknown.

HAB. On the face of rocks in bed of stream, Ben Narnain, Argyllshire, 1898 (*Dixon*).

Very distinct from all our British species; perhaps most resembling *B. atropurpureum*, which, however, has narrower more pointed leaves with recurved margins and distinctly narrower areolation. In habit and in its station it resembles *B. claviger* Kaur., a continental species, but is quite distinct under the microscope. In general appearance it is also a little like small forms of *B. filiforme*, but the areolation and general leaf structure is entirely different.

Short axillary gemmiform shoots sometimes occur on the stems.

32. Bryum argenteum L. (Tab. XLV. L.).

In close tufts or patches, ½–1 inch high, *pale green or whitish, silvery and shining when dry, slender, with terete julaceous branches*. Leaves *closely imbricated*, hardly altered when dry, *small, widely ovate or obovate*, variously apiculate or acuminate, *very concave*, margin *plane*, entire; nerve thin, *vanishing considerably below the summit;* cells *small*, narrowly hexagonal; usually somewhat vermicular, obtuse at the ends, and incrassate; wider at base; *all very pellucid, the lower very slightly chlorophyllose, the upper, often for half the leaf, quite colourless and hyaline*. Seta *short*, about ½-inch high, arcuate at the top; capsule pendulous, rarely more horizontal by the stronger curving of the seta, *very small*, hardly 1 line in length, *shortly oblong*, with a very short hardly tapering neck, slightly contracted below the wide mouth when dry, reddish brown, lid wide, conical, orange; peristome deep orange below, paler above. Dioicous.

Var. *β. majus* B. & S. (*B. perpusillum* Stirt. in Glasgow Nat. vi, 38). In *taller*, swollen, *greener* tufts; branches stouter; leaves *chlorophyllose almost to apex*. Capsule hardly raised above the branches.

Var. γ. *lanatum* B. & S. (*Mnium lanatum* P. Beauv.). Shorter with shorter branches, *hoary with the long, flexuose, hyaline, acuminate points* of the leaves, *chiefly or entirely formed of the percurrent or excurrent nerve, very white when dry.*

HAB. Waste ground, cinders, roofs, etc. Abundant. The varieties β and γ more rare; var. *majus* in moister, shady situations; var. *lanatum* in dry, warm spots. Fr. late autumn.

One of the most easily recognised of our species, resembling most *Plagiobryum Zieri*, but differing in the smaller cells, absence of red tinge and other points mentioned under that plant. The silvery tint is due to the extreme thinness of the texture of the leaves, the upper part usually devoid of chlorophyll, and the lower half only faintly coloured. It exhibits some variation in leaf form and habit, but hardly to such an extent as not, in general, to be easily recognised. The varieties described above are the extreme forms induced, the one by a rich and moist habitat, the other by drought and exposure to the sun. In the var. *lanatum* however a very distinct structural change occurs through the nerve becoming prolonged into the acumen, and frequently, indeed in the best marked forms normally excurrent.

B. parasemum Stirt. may belong here; or possibly to *B. atropurpureum*; in any case it is only an abnormal state of some species.

F. RHODOBRYUM.

33. Bryum roseum Schreb. (*Mnium roseum* Weis; *Bryum proliferum* Sibth., Braithw. Br. M. Fl.) (Tab. XLV. M.).

Gregarious or in large loose mats; producing subterranean stolons, with stems 1–2 inches high, somewhat branched, robust, clothed for some distance upwards with *minute, appressed, scale-like leaves*, the terminal suddenly enlarged, *forming a wide terminal rosette*, deep green, horizontally spreading or erecto-patent, erect and flexuose when dry, *very long, 3-5 or even 6 lines*, 1½ lines wide, *spathulate from a narrow base, acute, the apex somewhat* twisted; margin narrowly recurved below and entire; in the upper half plane, *spinulose-dentate*; nerve narrow above, *vanishing at some distance below apex*. Areolation rather large, *regularly elongate-hexagonal*, larger and looser at base, all thin-walled and highly chlorophyllose, or the lowest hyaline. Capsules often two or three together, on long stout setae 1–1½ inches high, pendulous, oblong-cylindrical with a short neck, slightly incurved, brown; lid conical, obtusely apiculate; peristome large. Dioicous.

HAB. Woods and shady hill-sides, not common. Fruit very rare, late autumn.

A splendid plant, with beautiful rosettes of leaves sometimes as much as an inch across. The stems are frequently continued beyond one rosette, subsequently forming another, and innovations are produced below the flowers. In habit this species resembles a Mnium, such as *M. spinosum*, but the areolation is quite Bryoid, as is the peristome. The fruit is exceedingly rare, and has only been found in three or four British localities.

79. MNIUM L. (emend. B. & S.).

Plants usually *tall and robust with large leaves*. Fertile stems erect, the terminal leaves usually larger, forming a rosette; often producing barren basal branches of a different form, frequently long, slender and prostrate or arched, rooting at the ends, the leaves sub-equal; branching basal, rarely from below the inflorescence. Leaves usually large, rounded or more or less elliptic or lingulate, *often with a distinct border, frequently spinosely toothed;* nerve rarely longly excurrent; cells *rounded-hexagonal or quadrate-hexagonal*, rarely elongate, often large, smooth. Capsule more or less pendulous or horizontal, oblong-cylindric or oval, *not pyriform;* lid *mamillate, acuminate or rostrate;* calyptra very narrow, fugacious. Peristome as in the Section Eu-Bryum of Bryum, but with the cilia smooth or nodose, hardly appendiculate.

A genus of very fine, handsome mosses, with large pellucid leaves, usually with a border, which is much more distinct than in Bryum, and sometimes thickened; and with very different areolation, the cells being nearly as broad as long (except at the base) and hardly ever rhomboidal. The capsule also is different, being more frequently horizontal, rarely with a distinct or tapering neck, and hence not pyriform in outline; the lid too is frequently beaked. The prostrate or arched barren shoots are only present in a certain number of our species, in the others the barren innovations are erect, but with the leaves sub-equal, and are usually taller and more slender than the fertile ones.

DERIV.—*μνιον* (mnion), moss.

1 { Leaf margin entire....2
  { Leaf margin toothed....4

2 { Marginal cells scarcely distinct, all cells rather elongate *12. cinclidioïdes*
  { Marginal cells long and narrow, forming a distinct border....3

3 { Margin usually thickened (2-4 stratose); dioicous; capsule oval *13. punctatum*
  { Margin not thickened, 1-stratose; synoicous; capsule roundish *14. subglobosum*

4 { Ls. not bordered....*11. stellare*
  { Ls. bordered....5

5 { Border simply serrate, the teeth single, in one rank....6
  { Border with the teeth in pairs in a double rank....9

6 { Ls. ligulate, obtuse, undulate....*4. undulatum*
  { Ls. ovate or roundish, scarcely undulate....7

7 { Stem 1-3 inches; cells 26-40 μ, in divergent rows....8
  { Stems ½-1 inch; cells about 20 μ, not arranged in rows....*2. cuspidatum*

8 { Dioicous; ls. usually acute; lid conic....*1. affine*
  { Synoicous; ls. usually obtuse; lid rostrate....*3. rostratum*

9 { Ls. lanceolate, scarcely decurrent; lid mamillate....*5. hornum*
  { Ls. wider, with longish decurrent wings; lid conic, rostrate....10

10 { Cells in divergent rows ; ls. 2-3 lines long ..... *10. spinosum*
Cells not arranged in rows ; ls. 1½ line or less 11

11 { Cells hexagonal, small, about 12-15 μ ; dioicous ..... *7. orthorrhynchum*
Cells rounded at the corners, about 20 μ 12

12 { Synoicous ; nerve not spinulose at back ..... *6. serratum*
Dioicous ; nerve usually spinulose at back 13

13 { Ls. somewhat distant, much shrinking when dry, plant of banks of streams ..... *9. riparium*
Ls. close, sharply toothed, not much shrinking, plant of mountain rocks *8. lycopodioides*

1. Mnium affine Bland. (*M. cuspidatum* Neck., Braithw. Br. M. Fl.) (Tab. XLVI. A.).

Stems usually moderately tall, with long sterile shoots *arched or prostrate ;* bright pale green, loosely tufted, 1–2 inches high, radiculose below. Stem-leaves ovate, the upper larger, *oblong-elliptic, usually somewhat acute* rarely more obtuse and apiculate, 2½–3½ lines long, narrowed and decurrent at base ; leaves of sterile shoots usually complanate in two rows, more distant, wider, ovate or obovate-spathulate, often hardly narrowed at base and scarcely decurrent, largest in the middle of the shoot ; all much crisped, curled and undulate when dry, margin *bordered* with 3–5 rows of narrow-linear, cartilaginous cells, yellowish, spinulose in the upper half with *a single row of sharp, rather distant, slender teeth* usually composed each of a single row of three cells, but variable ; nerve reaching to apex or vanishing in the apiculus ; cells *large*, variable in size (*25–40 μ*), broadly oval-hexagonal, arranged in oblique lines radiating from the nerve, at apex rather smaller and more rounded, at base larger and sub-rectangular, all chlorophyllose, thin-walled, scarcely collenchymatous. Capsules *usually aggregated*, 2–4 together, on long setae (1–1½ in.), pendulous, elongate-elliptic, 2 lines in length, yellowish brown, finally brown ; lid *conical, apiculate*. *Dioicous*. Male flower discoid, terminal.

Var. *β. elatum* B. & S. (var. *elatum* and *M. Seligeri* Jur., Braithw. Br. M. Fl.). *Tall*, robust, 2–4 inches high, *sterile branches erect ;* leaves *large, less strongly spinose with short blunt teeth*, usually of 1–2 cells each ; areolation usually smaller, more incrassate, sometimes slightly collenchymatous ; leaves more markedly decurrent.

Var. *γ. rugicum* B. & S. (*M. rugicum* Laur.). *Small*, dull green, leaves *small*, short, margin *almost entire or with only a few obtuse almost obsolete teeth.*

Hab. Damp ground in woods, etc. Common. The vars. *β*, *γ*, in bogs and marshes, less common. Fruit rare, in spring.

This species varies very greatly, and is difficult to describe with precision. It could only however be confused with the two following species, and of these *M. cuspidatum* has the leaf-cells very markedly smaller, indeed only

about about half the size; while *M. rostratum* differs in the synoicous inflorescence, and the rostrate lid. When these characters are not present there is frequently some difficulty in the determination; but *M. rostratum* has generally more oblong, obtuse leaves with the serratures usually very small and often all but wanting; they are also less decurrent, and broader at the base, but it is not always safe to determine barren specimens. *M. affine* is usually a more robust species than either of the other two.

I am unable to consider *M. Seligeri* Jur. a good species. The differences between it and the var. *elatum* of *M. affine* at the best are but slight, and the form of the serratures, which appears to furnish the most important character, is very variable, and leaves may be found on the same stem exhibiting the normal type together with that of *M. Seligeri*, and with intermediate stages. The tall fine plants with the sterile shoots erect are very different from typical *M. affine*, but this is also characteristic of the var. *elatum*. I have not found the convex form of the leaves, the strongly decurrent base, the smaller incrassate cells, and the small obtuse serratures, at all constantly correlated. Thus in German specimens distributed as *M. insigne* Mitt. (*i.e. M. Seligeri* Jur.) by Dr. Fr. Mueller, with the typical short blunt serratures, the leaves are hardly decurrent, the cells very large, and the cell-walls not at all incrassate; on the other hand, fine fruiting plants collected by Grebe in Thuringia and distributed as *M. Seligeri* (but which should doubtless be classed as *M. affine* var. *elatum*), have the spines very long and slender, formed of three cells, but the leaves very strongly decurrent, and convex on the upper surface.

2. **Mnium cuspidatum** Hedw. *non* Neck. (*M. silvaticum* Lindb., Braithw. Br. M. Fl.) (Tab. XLVI. C.).

Less robust than *M. affine;* young shoots bright pale green, older stems dark green; in wide patches. Sterile shoots *prostrate or sub-erect*, slender. Stem leaves decurrent, oval-oblong, the upper larger, 1–2 lines long, *obovate-spathulate;* those of the branches shorter, smaller, rounded-oval; all *acute, shortly cuspidate*, much crisped when dry; border of 3–5 rows of yellowish cells, *with a single row of small spinose teeth* in the upper half, each tooth as a rule composed of a single spiniform cell; nerve vanishing below or in the cuspidate point. Cells *small, about 20 μ in diameter*, hexagonal, somewhat incrassate and collenchymatous, not seriate, at apex rather smaller, at base somewhat larger and longer, sub-rectangular. Seta pale, *solitary;* capsule pale, sub-pendulous, oval-oblong, lid *conical, obtuse;* peristome yellow. *Synoicous.*

HAB. Damp ground and rocks in woods, etc.; common. Fr. spring.

A smaller species than the last, and readily distinguished from that and *M. rostratum* by the cells only about half the size, not arranged in radiating rows, and more angular. It may be recognised in the field by the smaller, shorter, more acute leaves, with the borders more finely and sharply toothed. All the other species with bordered and serrated leaves have them usually narrower and longer and always with double rows of teeth.

3. Mnium rostratum Schrad. (Tab. XLVI. B.).

Dark green, in loose patches. Stems erect, short, sterile branches long, *prostrate or arched*. Leaves usually *oblong or slightly obovate*, less tapering at the base, *rounded and obtuse and often flattened at the summit*, with a short apiculus, slightly decurrent, crisped and undulated when dry; those on the sterile shoots two-ranked, somewhat complanate; comal leaves of the stems much enlarged, 2–2½ lines long; margin strongly bordered, with *a single row of irregular teeth* in the upper half, which are usually small, thick, and obtuse, often almost obsolete; *nerve reaching apex*; cells resembling those of *M. affine*, but a little smaller, *about 25 μ in their shortest diameter, collenchymatous*, and often slightly incrassate. Capsules often aggregate, horizontal or sub-pendulous, oblong-oval, pale; lid *with a long, straight or curved, rostrate beak*, yellow; calyptra rather persistent; peristome yellow. *Synoicous*.

Hab. Rocks and shady banks; frequent. Fr. spring.

Easily distinguished from the two preceding species, when in fruit, by the long beak of the lid. When barren the more oblong, obtuse leaves will generally distinguish it, besides which the cells are larger and the serratures more obtuse than in *M. cuspidatum*; but as observed under *M. affine*, it is sometimes, in the barren state, more difficult to separate from that species. The collenchymatous cells will usually serve to distinguish it, as the forms of *M. affine* with similar cells are nearly always those of var. *elatum* with erect branches, thus differing in habit from our present plant. The leaves of *M. affine* are also as a rule more strongly decurrent. Even without the fruit, it may readily be known by the synoicous inflorescence, when flowers are present. It often grows with *M. punctatum*, which is easily known however by its larger, wider, entire leaves of firmer texture and much less altered in drying.

M. rostratum is occasionally dioicous, and such forms have been described as new species in several parts of the world. Mr. C. P. Hurst has gathered a remarkable form in Savernake Forest with the leaves quite entire; it is sterile, but if it should prove dioicous, as is possible, it would be identical with the Indian *M. integrum* Fleisch. In any case I can hardly look upon it as anything but a varietal form.

4. Mnium undulatum L. (Tab. XLVI. D.).

In large loose patches, bright pale green or darker. Stems 1–2 inches high, erect; sterile branches longer, 3–4 inches, *erect, somewhat arcuate and often flagelliform, dense-leaved*; stems branched from the coma and stoloniferous at base. Stem-leaves gradually larger upwards, the comal *long (often ½ an inch), lingulate, obtuse and round at apex*, with a small apiculus chiefly formed by the slightly excurrent nerve; narrowed at base and decurrent, *strongly transversely undulate*; crisped when dry; leaves of the sterile shoots similar. Nerve strong, slightly excurrent; margin with a narrower border than in the three preceding species, spinosely serrate from the base *with close, acute teeth in a single row*.

Cells small, *about 15 μ in diameter*, transversely elliptical-hexagonal, somewhat seriate. Capsules aggregated, *2–10 in one perichaetium*, seta orange, paler above; capsule oval-elliptic, sub-pendulous, shining, pale reddish brown, with bright red mouth and lid; calyptra fugacious; lid *conical, obtuse or obtusely apiculate;* peristome pale. *Dioicous.* Male flower discoid.

HAB. Shady woods. Abundant. Fruit rare, spring.

One of our finest mosses, especially when the fruit is produced; the numerous setae springing from the terminal rosette of leaves, with the brightly coloured drooping capsules, render it especially beautiful. It can hardly be confused with any other moss; *Catharinea undulata* is the one which most resembles it, but is known at once by the more tapering, usually acute leaves, with lamellae on the face of the nerve.

5. Mnium hornum L. (Tab. XLVI. E.).

Robust, in dense tufts, 1–2 inches high, dark green, the young shoots pale green. Stems erect, unbranched; lowest leaves minute, upper gradually increasing in size, comal large, forming a rosette, terminal 1½–2 lines, *oblong-lanceolate or narrowly elliptic-lanceolate, more or less acute*, with a sharp apiculus, *very slightly decurrent*, erecto-patent or spreading, when dry erect, slightly twisted, but *hardly crisped or contorted*. Sterile shoots *erect*, the leaves sub-equal, *crowded*, not forming a comal rosette, resembling those already described. Margin of leaves with a strong reddish border, *spinosely serrate* from below the middle with a *double* row of teeth, which are consequently in pairs, each formed of a single spiniform acute cell; nerve ceasing *at some distance below* the apex, *spinose at back* above; cells incrassate, *angular*, sub-quadrate, hexagonal or irregular, not seriate, rather small, about 20 μ in diameter, the basal rectangular, elongate. Seta solitary, 1–1½ inches, reddish, cygneous above, capsule sub-pendulous, finally horizontal, rather large, ovate-elliptic with a very narrow but distinct tapering neck, when empty somewhat inflated, pale yellow with a narrow red rim; lid *conical, apiculate;* peristome yellowish. *Dioicous;* male flower large, discoid.

HAB. Sandy banks in woods, and about the roots of trees, sometimes on rocks by streams; common. Fr. spring.

A fine species usually known by its dense, robust habit, with the leaves closely set and hardly crisped when dry. It does not vary much, but when growing among rocks and by mountain streams it is often of a reddish hue and more slender, then much resembling *M. serratum* and *M. orthorrhynchum*. When in fruit the pale capsule and short lid at once designate it; but these species, especially the latter, are often barren, and it is then sometimes almost impossible to separate them in the field. There is, however, usually a more decided reddish tinge about *M. serratum* and *M. orthorrhynchum*, especially

in the stems; the leaves are less crowded, wider, more ovate, and more strongly decurrent; still lax-leaved forms of *M. hornum* may defy determination with the lens. Under the microscope the scarcely decurrent leaves and the shorter nerve will generally distinguish it; *M. serratum* also has the nerve not spinulose at back and the cells rounded internally, and in *M. orthorrhynchum* the cells are rather smaller.

M. hornum has something of the habit of *M. stellare*, but is usually of stronger growth, and its bordered leaves are quite distinct, even with the lens.

6. Mnium serratum Schrad. (*M. marginatum* P. Beauv., Braithw. Br. M. Fl.) (Tab. XLVI. F.).

Resembling *M. hornum*, but more slender, of a darker green, almost always *with a deep vinous red tinge* in the lower part and with red stems; leaves *shorter, wider, more distant*, more contorted when dry, but hardly crisped; lower stem-leaves ovate or obovate, upper longer, oblong-spathulate; all acute and apiculate, narrowed at the base and *strongly decurrent;* leaves of the sterile shoots more distant, shorter; all with a strong red border, *doubly spinose-serrate*, the teeth acute, obtuse, or sometimes almost obsolete, less crowded than in *M. hornum;* nerve red, vanishing just below or reaching to apex, smooth, *not spinose* at back; cells *20 25 μ in diameter, irregularly rounded, not angular*, slightly incrassate, collenchymatous, at base larger, sub-rectangular. Capsules sometimes aggregate, horizontal, yellowish brown, finally brown; lid with a rather stout *shortly rostrate beak*, usually decurved; peristome deep yellow, finally brownish. *Synoicous.*

HAB. Rocks, usually by streams; not common. Fr. spring.

M. serratum is a plant of alpine and sub-alpine regions, while *M. hornum*, though equally at home there, is more frequently found in lowland woods. The characters separating the two plants will be found under the latter species.

Mnium serratum is often quite indistinguishable in the field from *M. orthorrhynchum*, although the latter is usually somewhat more densely tufted with the leaves more crowded. Under the microscope the difference is easily seen, the cells in *M. serratum* being internally rounded, not angular, and half as large again in diameter as those of *M. orthorrhynchum*. *M. riparium* differs in its usually smaller size, more distant leaves, and dioicous inflorescence; *M. lycopodioides* in the inflorescence, and the nerve spinulose at back.

7. Mnium orthorrhynchum B. & S. (Tab. XLVII. A.).

Allied to the last species, but more closely tufted, with the leaves in the upper part of the stem and branches *more closely set, narrower*, oblong-lanceolate, doubly spinose-serrate from below the middle; nerve spinulose at back above; cells *angular, quadrate or hexagonal, small, about 15 μ in diameter*, chlorophyllose, incrassate, not collenchymatous. Seta about an inch

long, deep red, solid, solitary; capsule brown, together with the neck straight, not curved; cells of exothecium firm, about 30–35 μ in diameter; lid shortly rostrate, straight or oblique. *Dioicous*. Male flower discoid.

HAB. Calcareous rocks, especially in mountainous districts. Rare. Fruit very rare, late summer.

In its aspect and closely set leaves this species usually resembles a slender form of *M. hornum*, and is in this way often distinguishable from *M. serratum*, but by no means always. The toothed nerve, the dioicous inflorescence, and the small angular cells are the safest guides.

8. Mnium lycopodioides Schwaeg. (*Bryum lycopodioides* Hook.; *Mnium gracilentum* Stirt. in Ann. Scot. Nat. Hist. xvii, 173) (Tab. XLVII. B.).

Resembling *M. serratum* and *M. orthorrhynchum;* rather tall and robust, dark green, brown, *scarcely reddish* below. Leaves rather loosely set, resembling those of *M. serratum* or a little larger, *sharply toothed almost to base*. Nerve *toothed* at back above. Cells closely resembling those of *M. serratum* in size and form. Seta pale red, capsule larger than in *M. orthorrhynchum*, more brightly coloured, *reddish brown*, together with the neck *slightly decurved;* cells of exothecium *twice as large*, with thinner walls. *Dioicous*.

HAB. Shady mountain rocks. Ben Lawers, 1893 (*Dixon*); Craig Chailleach, 1902 (*Cocks*). Fr. rare, early summer.

A widely spread but not very common continental species, the distinguishing characters of which were well pointed out by Philibert in an article in *Rev. Bry.*, 1895. It differs essentially from *M. serratum* in the dioicous inflorescence, and also in the nerve which is spinose at back above; the habit is also somewhat different, the plants being rather more robust and rigid, and always I believe of a green, not vinous red colour. From *M. orthorrhynchum* which it resembles in the inflorescence it abundantly differs in the areolation, and also in the fruiting characters given in the description. It is more difficult to define the differences between it and *M. riparium*, but the characters which separate that plant from *M. serratum* distinguish it still more markedly from the present species, which in addition has the leaves more strongly spinose.

The fruit has not been found in Britain, only the female plant, referred to *M. riparium* in the 1st edition of this work.

9. Mnium riparium Mitt. (Tab. XLVII. E.).

Closely resembling *M. serratum*, but with more *distant broader leaves*, usually more quickly narrowed at the base, ovate-oblong; on the sterile shoots often rounded-ovate, less strongly and sharply toothed; cells resembling those of *M. serratum*, *about 20 μ in diameter, rounded, hardly angular*. Seta short, pale red; capsule horizontal or sub-pendulous. *Dioicous*.

HAB. Shady woods and rocks by water, very rare. Sussex; Herefordshire; Yorkshire; Cumberland; Perthshire. Fruit not found in Britain, spring.

Husnot (*Muscol. Gall.*) unites this with *M. serratum* as a variety, and it is indeed very near that species; as, however, it differs in habit and leaf-form as well as in the inflorescence, I have retained it as a species, but with some expectation that it may ultimately have to be united with the above. Although usually a much more slender plant, smaller in all its parts, it is not always so; the specimens distributed in the Musci Galliae (No. 724), for instance, by Geheeb, are by no means markedly so. I have, moreover, gathered sterile forms of *M. serratum* on muddy banks by the R. Wye, Herefordshire, which in habit and all available characters were precisely similar to *M. riparium*, and which in the absence of inflorescence I should certainly have referred to that species had it not been for a continuous chain of forms obviously connecting the plant in question with typical fruiting plants of *M. serratum* growing in the same place.

M. orthorrhynchum differs in the denser, narrower leaves with smaller, angular areolation, *M. lycopodioides* in the robust habit and strongly spinulose leaves. The serration in this as in the allied species varies considerably in acuteness and other points.

10. Mnium spinosum Schwaeg. (*Bryum spinosum* Voit) (Tab. XLVII. C.).

Tall, robust, loosely and irregularly tufted, 2-3 inches high, *dark dull green*. Sterile shoots erect or curved, resembling the fertile ones. Stems stout, rigid, almost naked at base, the lower leaves very small, scale-like, upper crowded, *very large, 3-4 lines long, 1½ lines broad, widely elliptic-oblong*, obtuse and apiculate or widely acute and shortly acuminate, narrowed at base and *longly decurrent;* spreading when moist, when dry erect, imbricated, twisted and undulate, but not strongly crisped; *solid in texture*, highly chlorophyllose; border *strong*, narrow, cartilaginous, often purple, of 2–4 rows of very narrow cells, sharply spinose from below the middle with *a double series of strong acute teeth*. Nerve *shortly excurrent* in a cuspidate acute point, reddish, spinose at back above. Cells chlorophyllose and opaque, the basal very narrow, rectangular; the upper *angular, irregularly hexagonal-rectangular, usually elongate*, about 20 μ in width, mostly arranged in curved lines radiating from the nerve, *strongly incrassate;* often a little larger towards apex. Capsules often aggregate; seta rather short, under an inch in height, capsule sub-pendulous, elliptical; lid shortly and stoutly rostrate; peristome reddish brown. *Dioicous;* male flowers large, discoid.

HAB. Shady rocks on mountains, very rare. Ben Lawers; Craig Chailleach; Clova. Fr. late summer.

A fine species, but of a dingy colour, and with us not easy to gather in good condition; it has only been very sparingly found in fruit in this country. Its large, wide leaves, very strongly decurrent, readily distinguish it from *M. hornum* and all the other allied species.

M. spinulosum B. & S., a closely allied species, smaller, of a brighter colour, and synoicous, is found on the continent in similar localities, but more rarely.

11. Mnium stellare Reich. (Tab. XLVII. D.).

Densely tufted, 1–4 inches high, *deep green or bluish green, soft.* Stems and sterile shoots erect, similar. Leaves gradually larger upwards, the upper rather crowded, *elliptic-oblong, decurrent,* when dry appressed, twisted and slightly crisped, rounded at the apex and acute, or obtuse and apiculate ; *not bordered,* margin with *a single series* of irregular rather distant spinulose *obtuse teeth* from below the middle ; nerve thin, vanishing below apex, not spinulose at back ; cells irregular, sub-hexagonal or sub-quadrate, usually angular, incrassate. Seta solitary ; capsule inclined or horizontal, oblong ; lid conical, obtuse ; peristome yellowish. *Dioicous.* Male flower discoid.

HAB. Shady woods and rocks, not common. Fruit very rare, summer.

Known by its soft tufts, the leaves broad (but exhibiting considerable variety in form), wanting the cartilaginous border which is conspicuous in almost all the other species, being especially shiny and noticeable in the dry state ; the colour also is somewhat different from that of any other species, and on the whole the plant is not difficult to determine, when once known ; under the microscope of course the non-bordered, toothed leaves at once distinguish it.

An allied continental species, *M. Blyttii,* has the leaves slightly bordered, the cells smaller, the teeth somewhat in pairs.

12. Mnium cinclidioides Huebn. (*Bryum cinclidioides* Blytt) (Tab. XLVII. F.).

Stems tall, robust, 3–6 inches, simple or with a few slender lateral branches ; sterile branches similar, longer and more slender. Loosely tufted, *bright or yellowish green,* glossy, black or grey below. Leaves *thin, large, rather distant,* lower ovate, upper *widely oblong-lingulate, rounded and obtuse with a minute apiculus,* somewhat undulate, when dry somewhat crisped ; *not bordered,* margin *entire* or very faintly irregular here and there with projecting cells ; nerve ceasing considerably below apex ; cells *rhomboid-hexagonal,* more or less seriate in radiating lines, 2–3 times as long as wide, about 20 μ in width, *thin-walled,* sparingly chlorophyllose ; the marginal in several rows parallel to the edge of the leaf longer and narrower, but not forming a distinct or cartilaginous border. Seta long, slender, capsules shortly oval, pendulous ; lid *conical, apiculate ;* peristome brownish. *Dioicous.*

HAB. Mountain bogs, rare. Fr. summer.

A very fine species, known at once from the two following plants, which it most resembles, by the blackish colour of the interior of the tufts, and the thinner leaves without a distinct border. The lowest, old leaves in this as in the following species often become iridescent.

13. Mnium punctatum L. (Tab. XLVIII. A.).

Tall, robust, 3–6 inches high, dark green; sterile shoots erect. Stems usually densely clothed with *reddish or dark brown* radicles. Leaves *large*, distant, the terminal 5–6 forming a rosette, larger, all patent, *of solid texture*, undulated and contracted when dry, but hardly crisped, *broadly obovate*, 3–4 lines long, 2–2½ lines broad, from a very narrow base, *not or hardly decurrent*, at apex *broad, flat, slightly emarginate, usually minutely apiculate;* border cartilaginous, *thickened, of 2–4 rows of cells in several layers, entire*, usually purplish brown; nerve reaching to the apiculus or ceasing just below, cells somewhat variable in size, large, angular, elongate-hexagonal, somewhat seriate in radiating rows, incrassate. Capsule on a long, pale seta, sub-pendulous, finally horizontal, *ovate-oblong*, pale yellowish when ripe, finally brown; lid *acutely rostrate*. Peristome teeth yellowish, darker at base; outer teeth and inner peristome *very finely and evenly papillose;* outer face of the teeth formed of oblong plates *6 or 8 times as wide as high;* inner face with *many* (*30–35*) dense transverse bars. *Dioicous*. Male flower discoid.

Var. *β. elatum* Schp. Tall, densely tufted. Leaves larger, *rounded at summit without an apiculus*, with a *narrower, hardly thickened* border; nerve *ceasing at some distance below apex*.

Hab. Damp sandy and rocky places. Common. The var. *β* on mountains. Fr. spring.

Except *M. cinclidioides*, which has thinner, non-bordered leaves, there are no species of the present genus with which this plant is likely to be confused, but *M. subglobosum*. The latter differs essentially in the synoicous inflorescence, and usually, but not always, in the shorter, sub-globose, pendulous capsule and the narrow, pale, not thickened border to the leaves, which are also not apiculate and have the nerve shorter. All these last vegetative characters are however sometimes found in the present species, notably its var. *elatum*, as are also, according to Amann (*Rev. Bry.* 1890, pp. 53 sqq.), the form and direction of the fruit. According to this author it is quite unsafe to separate these ambiguous forms except by the inflorescence or by the characters of the peristome italicised under each species, which are however easy of determination.

Cinclidium stygium differs in the deeper colour, smaller, rounded-spathulate leaves, with longer, more distinct apiculus, etc. A small, dense form, however, of the present plant occurs with small, very concave, rigid leaves, much resembling Cinclidium in general appearance, though generally known at once by the nerve ceasing below the obtuse, scarcely apiculate leaf-apex; the characters are most marked in the male plant.

14. Mnium subglobosum B. & S. (*M. pseudopunctatum* B. & S., Braithw. Br. M. Fl.) (Tab. XLVII. G.).

More slender; resembling the var. *elatum* of the last species; the border of the leaves *not thickened, less distinct and less coloured*, of 1–3 rows only of thin, narrow cells; *obtuse and emarginate*,

with the nerve ceasing considerably below the summit. Capsule *small, short, sub-globose, usually pendulous* Peristome brown all over; outer and inner with papillae, forming *an irregular network of lines;* plates of the outer surface of the teeth only *2–4 times as wide as high;* transverse bars of inner face *less numerous* (*15–25*) and more distant at the base of the teeth. *Synoicous.*

HAB. Bogs and marshes, rare. Fr. spring.

This species, according to Amann, often grows intermixed with the foregoing, and can hardly be separated from some forms of it without the inflorescence or the capsule with peristome. It is usually, but not constantly, much more densely tomentose than is common in that species.

80. CINCLIDIUM Swartz.

A genus of mosses closely resembling certain species of Mnium, such as *M. punctatum*, in habit and foliage. Capsule similar, lid convex; peristome teeth *short, obtuse, incurved;* inner peristome *of 16 narrow-linear processes from a very narrow basal membrane, supporting a dome-shaped cupola.* Spores *large.*

The peristome with its elegant dome-like membrane supported on slender pillars, between which the obtuse outer teeth curve inwards, forms the main character by which Cinclidium is separated from Mnium. There are several other species, all confined to northern latitudes.

DERIV.—κιγκλιδ-(kinklid) a lattice. From the appearance of the cupola-like inner peristome.

1. Cinclidium stygium Swartz (Tab. XLVIII. B.).

Resembling the less luxuriant forms of *Mnium punctatum;* but always with *a strong reddish tinge*, often deep purplish black, the young shoots only being green; stems *densely interwoven with dark purple tomentum.* Leaves rather small, lower distant, upper crowded in a terminal rosette, rounded-ovate or obovate, from a narrow base, *obtuse with a short wide apiculus;* when dry *crisped and undulate.* Border *strong, red, not thickened*, of several rows of narrow cells, entire or denticulate in the apiculus only; nerve strong, red, *reaching apex and confluent with the border in the apiculus.* Cells resembling those of *Mnium punctatum.* Seta long; capsule *pendulous, elliptic-oblong*, rather wide-mouthed when empty; lid conical, *obtuse;* peristome pale yellow, the inner orange. *Synoicous.*

HAB. Deep bogs on mountains and moors, rare. Fr. summer.

Although much resembling *Mnium punctatum* this interesting moss will readily be distinguished by the characters italicised above. The peristome is a beautiful object.

** *Diplolepideae Pleurocarpae* (*v. ante, p. 255*).

Pleurocarpous mosses; *i.e.*, the fruit is produced from a *lateral* bud on *the side* of the stem or branches, not at the apex. Stems usually more or less prostrate, with the branching frequently pinnate or sub-pinnate (branches frequently erect), rarely dichotomous.

[The seta in the pleurocarpous mosses may appear to be terminal on a very short lateral branch, but this will be found on examination to be only an elongation of the perichaetium, originating in a lateral bud on the stem, containing the archegonia; the elongation taking place after fertilisation, and belonging therefore to the sporophyte. The peristome is that of the Diplolepideae, and in the majority of the genera and species closely resembles that of the Bryaceae.

It is a curious fact that throughout the pleurocarpous mosses the inflorescence is almost always autoicous or dioicous, very rarely, indeed exceptionally synoicous.

The stem-leaves often differ in form and other characters from those of the ultimate branches. In the following descriptions unless otherwise explained, the term leaves refers to those of the secondary stems; the primary stem being as a rule inconspicuous, often leafless, or with only rudimentary leaves, so that it may be termed stoloniform.]

ORDER XIX. FONTINALACEAE.

Aquatic, floating mosses, adhering only at the base; usually much elongated. Leaves in several rows or tristichous, nerveless or single-nerved, cells rhomboid-hexagonal or linear and sub-vermicular, long, smooth. Capsule immersed or shortly exserted; annulus none. Calyptra cucullate or mitriform, glabrous. Peristome of 16 outer teeth, transversely articulate and trabeculate on the inner face, and an inner peristome of 16 cilia more or less completely united with one another by transverse partitions at regular intervals.

A very distinct Order of mosses, known at once by their aquatic habit, the areolation of their leaves at once distinguishing them from Cinclidotus, and the hardly exserted or even immersed capsules from the aquatic Hypneae. In the absence of fruit there is, indeed, a close resemblance between some of the Harpidioid Hypneae and the species of Dichelyma, but the latter may usually be known by the long nerve reaching the summit or excurrent, which is rarely the case in the Hypneae.

Dichelyma differs from Fontinalis in the nerved leaves, in the capsule exserted on a short seta, and in the cilia of the inner peristome united only at their tips, or entirely free, not coherent throughout their length. One species, *D. capillaccum* B. & S., has been recorded by Dickson from Scotland; but there is too much uncertainty as to the native origin of the specimens to allow the plant, which has never been found since, to be considered a British moss. It somewhat resembles robust forms of *Hypnum fluitans*, but is known by the strong, slightly excurrent nerve.

81. **FONTINALIS** Dill.

Leaves *nerveless*, often tristichous. Inflorescence dioicous. Capsule *sessile or sub-sessile*, *immersed or emergent* among the closely imbricated perichaetial bracts, on a rather elongated perichactial branch. Calyptra *conical;* outer peristome teeth 16, long, linear, entire or perforated, free or united in pairs at the tips, inner *a lattice-like cone*, open at the apex, composed of 16 cilia united by transverse bars.

Up to the publication of this work there had only been two species of Fontinalis recorded from the British Isles, viz., *F. antipyretica* and *F. squamosa*. Several doubtful plants, however, have been submitted to M. Cardot, the well known authority on the genus and author of the Monographie des Fontinalacées, and of these two have been determined and described by him as new species, viz., *F. Dixoni* and *F. dolosa* (considered here as sub-species of *F. squamosa* and of *F. antipyretica*); two others, *F. seriata* Lindb, and *F. dalecarlica* B. & S, being newly recorded for Britain.

DERIV.—Latin *fontinalis*, belonging to springs or water.

1 { Ls., at least the lower, folded and keeled at back.....2
  { Ls. not keeled, plane or concave.....3

2 { Branch-leaves keeled, somewhat rigid; capsule almost immersed *1. antipyretica*
  { Branch-leaves not keeled, plane or nearly so, soft, capsule half exserted *1.* dolosa*

3 { Ls. widely cymbiform, obtuse or sub-obtuse.....*1. antipyretica* var. *β*
  { Ls. ovate-lanceolate, or lanceolate, acute.....4

4 { Ls. shortly pointed; concave.....5
  { Ls. longly and gradually tapering.....6

5 { Ls. usually large, 1½ lines long or more, glossy.....*2. squamosa*
  { Ls. small, 1 line long, narrow, scarcely glossy.....*2*. dalecarlica*

6 { Ls. wide, ovate-lanceolate, auricles conspicuous.....*2*. Dixoni*
  { Ls. very narrow, linear-lanceolate, auricles none or faint.....*3. seriata*

1. Fontinalis antipyretica L. (Tab. XLVIII. C.).

Stems *very long*, sometimes attaining 3ft. in length, slender and flexuose, irregularly divided; the primary divisions bearing somewhat pinnate branches: the lower part of the stem usually denuded of leaves; usually dark green, sometimes golden brown. Leaves *in three rows, more or less imbricated, sharply keeled at the back and folded so as to be equitant* (cf. section, Tab. XLVIII. C. 1x.), *giving a triquetrous appearance to the stems, rigid*, little altered when dry, erecto-patent and often somewhat incurved above, 2½-3 lines long, 1-1½ lines wide, *widely ovate or ovate-lanceolate*, acute or apiculate, rarely obtuse, entire, margin plane, one or the other sometimes reflexed at base; cells variable in width, rhomboid-hexagonal or linear-rhomboid and vermicular; the basal angular ones wider, hexagonal-rectangular, sometimes forming distinct auricles; all *thin-walled*. Perichaetial bracts closely imbricated, the upper wide, sheathing, truncate-rounded, entire or often eroded and lacerate; capsule almost sessile, nearly immersed, oblong-cylindrical, olive green; lid longly and narrowly conical, readily deciduous, reddish; peristome *bright coral-red*, outer teeth incurved and contorted when dry; inner united by regular transverse bars into a perfectly formed, bright red, latticed cone.

Var. *β. gigantea* Sull. *Very robust*, less branched, older leaves of a coppery brown, *very wide* (*1½–2 lines*), *less acute*, curved on the keel; capsule smaller, peristome less perfect.

Var. *γ. gracilis* Schp. (*F. gracilis* Lindb.). *Slender*, often reddish; stems much divided, denuded for some distance at the base; leaves *narrow, lanceolate, smaller*, often split along the keel, which is *almost straight*; auricles more distinct; capsule smaller, *usually contracted below the mouth*.

Var. δ. *cymbifolia* Nicholson (Journ. of Bot., Dec., 1901). Soft in texture, stems *not or scarcely triquetrous*; leaves *wide, obtuse or sub-obtuse*, boat-shaped, *very concave, rounded and scarcely keeled at back*; cells *wider and shorter*.

HAB. Ponds, rivers, etc. Common. The var. *β* rare. The var. *γ* in mountain streams. The var. δ rare; Sussex; Bucks.; Northamptonshire; Hunts. Fr. summer.

A very variable plant, out of which numerous varieties and sub-species have been constructed. The leaves vary greatly in width, length and position, causing a great variety in the habit of the plant; they are usually conduplicate, the keel very acute; when this is the case it often happens that the leaf splits along the keel into two similar halves, each of which has much the aspect of a single, un-keeled leaf of *F. squamosa*; less commonly the keel is obtuse or indistinct, and very rarely it may be entirely wanting in many of the leaves, this is most frequently the case with the branch leaves; it is typically nearly straight, but may often be curved, like the keel of a canoe. The cells vary very much in width; on the laxer-celled forms they usually increase in width gradually to the base, so that the alar cells are hardly noticeable; but in the narrower-celled forms these cells are frequently suddenly dilated so as to form distinct auricles, the median basal cells being always extremely narrow and thus contrasting strongly with the alar ones.

The stems are usually attached to stones or stumps of trees by the side of the water. When the plant is totally submerged it rarely fruits, but when this does take place, as often happens in hot summers when the plant is left high and dry, the capsules are often produced in great numbers. The peristome is a beautiful microscopic object.

The limits of the variety *gigantea* are somewhat vague, as they are also in the case of the var. *gracilis*. The latter is the usual form in swiftly flowing mountain streams, occasionally growing with and passing into the typical form; it is frequently of a bright glossy, golden brown colour, and is very different in habit from the type, somewhat resembling *F. squamosa* at first view. Another alpine form, var. *laxa* Milde, has the leaves obtuse or obtusely pointed, and very divergent even when dry. This has been gathered at Malham Cove, Yorkshire. Mr. Cheetham has gathered in the same locality a somewhat similar plant but with narrow, flaccid, scarcely keeled leaves, which may possibly be *F. arvernica* Ren., but which needs further study.

*** Fontinalis dolosa** Cardot in litt. (Tab. XLVIII. D.).

Stem-leaves conduplicate, when old frequently splitting longitudinally; branch-leaves *much smaller and narrower, almost plane*, as are also the upper stem-leaves; *all soft*. Perichaetial leaves finally *truncate-laciniate*. Capsule usually *half-exserted*, when dry *somewhat constricted below the mouth*, smaller than in *F. antipyretica*. Peristome strongly papillose, outer teeth narrowly linear-acuminate, often united in pairs at apex, with 25–30 lamellae; inner peristome perfect.

HAB. On logs in ponds, Limbury, Bedfordshire, 1882 (*Saunders*); Essex; Staffordshire; Shropshire.

The above is a translation of M. Cardot's description, to which he adds: "Allied to *F. Kindbergii* Ren. and Card., but distinguished by its soft leaves, those of the branches almost plane, not channelled, only slightly folded longitudinally; and by its half-exserted capsules, lightly constricted below the mouth when dry. By its soft leaves, those of the branches almost plane, and its half-exserted capsule, this species recalls at first sight *F. hypnoides*; but the stem-leaves distinctly conduplicate show it to belong undoubtedly to the Tropidophyllae, and it is nearly allied to *F. Kindbergii* R. & C."

In some of the specimens the capsules are strongly constricted below the mouth, and this and the half-exserted position give them a markedly different appearance from those of *F. antipyretica*; in addition to which the rather

distant, flaccid, narrow branch-leaves, which are almost flat and not at all keeled, are very distinct, and it is indeed by the lower stem-leaves alone that it is seen to be really allied to *F. antipyretica*, to which I attach it as a sub-species, in which position *F. Kindbergii* is placed by Cardot (*Rev. Bry.*, 1891, p. 82).

2. Fontinalis squamosa L. (Tab. XLVIII. E.).

Resembling *F. antipyretica* var. *gracilis*, but with *smaller, narrower*, acute, ovate-lanceolate or lanceolate leaves, 1½–2 lines long, *concave, rounded and not keeled at back*, entire or sub-entire at apex, *glossy;* cells narrow, the walls firm and *somewhat incrassate;* one or two rows at margin usually much narrower and more incrassate, forming an indistinct border. Capsules closely resembling those of that species, but rather smaller, 1½ lines long, very slightly emergent; peristome teeth with numerous (25–35) lamellae. Spores 20–30 μ.

Var. β. *Curnowii* Card. Rather soft, yellowish, primary divisions of the stem numerous, elongated, with few branches; leaves *somewhat distant*, erecto-patent. *Perichaetial leaves abruptly apiculate.* Capsule *immersed.*

Hab. Mountain streams and cascades; not uncommon. The var. β, Penzance (*Curnow*); near Taxal, Cheshire (*Rogers, 1878*). Fr. rare, summer.

F. squamosa is a variable species, sometimes approaching *F. antipyretica* in robustness, but usually a more slender plant. The var. *Curnowii* is described by Cardot as a lax form, slightly softer than the typical plant, especially remarkable for its apiculate perichaetial leaves, a character which allies it to *F. dalecarlica.*

The concave, rounded leaves form the most obvious and most important character by which the present species is separated from *F. antipyretica* on the one hand and from *F. seriata* on the other; the characters separating *F. Dixoni* are pointed out under that plant.

Care is however needed lest slender mountain forms of *F. antipyretica*, which often have the young branch-leaves hardly keeled, and the older stem-leaves split into halves, be mistaken for it. It is usually safest to examine the lower leaves on the primary divisions, rather than those of the branches. The colour is usually of a darker, duller green than in the last, the stems very numerously divided, but the divisions very little branched. The leaves are often regularly and markedly arranged in three series.

*** Fontinalis dalecarlica** B. & S. (Tab. XLVIII. F.).

Allied to *F. squamosa*, and resembling slender forms of that species, but less glossy. Leaves *smaller*, sub-entire or with a few sharp teeth at apex, more appressed; leaf-cells not suddenly narrowed and incrassate at margin, several rows towards margin gradually slightly narrowed, not forming a distinct border. Perichaetial bracts sharply apiculate; capsule *smaller*, 1 line long, immersed; peristome teeth *shorter, more slender*, with *fewer* (14–22) more distant lamellae. Spores 25–32 μ.

HAB. In similar localities, very rare [near Princeton, Dartmoor, 1894 (*Dixon*). Rivulet near Lough Bray, Co. Wicklow, July, 1802; in herb. Hook.]. Fr. very rare, summer.

The claim of *F. dalecarlica* to be recorded as a British plant is somewhat doubtful. The specimen from Dartmoor sent to M. Cardot was without fruit, and he remarks upon it: "In spite of the absence of fruit, I think this specimen may be referred with certainty to *F. dalecarlica* B. & S., a species new to the British Is." Since then I have detected a single, old capsule, which in its small size agrees with the present sub-species, but the peristome is too fragmentary to afford any evidence; the spores are about 30 μ in diameter.

The differences between the present plant and *F. squamosa* are not great, and are chiefly ones of degree; most authors, however, have considered it a distinct species, or at least a sub-species; Husnot being the only author, so far as I am aware, who reduces it to a variety of *F. squamosa*. It has a somewhat distinct appearance, and may perhaps be known by its slender habit and very small, narrow, usually erect and somewhat appressed leaves. The angular cells in my specimens are large and very distinct, and form well-defined auricles.

The character drawn from the glossiness or otherwise of the plants, and from the marginal areolation, I have at times found elusive and very difficult to verify, although *F. dalecarlica* is almost entirely without the gloss that occurs very frequently—not constantly—in *F. squamosa*. The distinct coloured border of narrow, incrassate cells is not always pronounced in *F. squamosa*, and the gradual narrowing of the cells towards margin is at times equally ill-defined in *F. dalecarlica*; such as it is, however, it goes to prove that the Dartmoor plant must rather be considered *F. squamosa*. (A very similar fruiting plant gathered in Yorkshire by Ingham is shown by the peristome to belong to the latter.) On the other hand, the Irish plant in the Kew Herb., cited above, exactly agrees in habit, want of gloss, areolation, and sharply denticulate leaf apex with continental specimens of *F. dalecarlica*, and I have little doubt it belongs there, as may other herbarium specimens labelled *F. squamosa*; fruit is, however, wanting to make the identification quite certain.

*** Fontinalis Dixoni** Cardot in litt. (Tab. XLVIII. G.).

Stems rather short, moderately branched; plant of a dull *reddish brown* colour, golden brown when old, somewhat rigid. Branches frequently curved at the tips. Leaves *rather large*, 2 lines long or more, crowded, somewhat rigidly divergent, *ovate-lanceolate, gradually tapering and longly but widely acuminate*, entire or obscurely denticulate at apex, *slightly concave*, one margin usually inflexed; areolation narrow, with thick walls, angular cells *very large, pellucid, orange-brown, forming very conspicuous, inflated, decurrent auricles*. Branch-leaves much smaller, narrower. Fruit unknown.

HAB. Very rare. N. Wales; Central England; Scotland.

M. Cardot describes this plant as "belonging to the group Lepidophyllae; differing at first sight from *F. squamosa* by its leaves much more longly tapering-acuminate, and also by its more distinct auricles. Much more robust and with larger leaves than *F. dalecarlica*, which has, moreover, a quite different habit."

The colour, the hardly concave, much attenuated leaves, and above all the very marked auricles, render this plant certainly conspicuously distinct from *F. squamosa*, its nearest ally; it is however a question whether it should be regarded as an independent species or as a sub-species of that plant.

During the last few years it has been detected in two or three localities in N. Wales, keeping its characters fairly well; one or two plants, however, have shown a tendency to intergrade with *F. squamosa*, to which it is at the best nearly allied, and I have thought it better on the whole to make it a sub-species of that plant.

3. **Fontinalis seriata** Lindb. (Tab. XLIX. A.).

Very soft and slender, deep green, blackish below, resembling the most slender forms of *F. squamosa*. Leaves arranged more or less distinctly *in three rows, very narrow, linear-lanceolate from a very narrow base, very gradually tapering to a long slender point; plane or slightly concave only*, very flaccid and falling together when removed from the water. Cells rather short and wide, *thin-walled*, at basal angles somewhat lax, but not forming distinct auricles. Fruit unknown.

Hab. Mountain streams; very rare. R. Wye, Winforton, Herefordshire 1895 (*Binstead*).

M. Cardot in his "Tableau methodique du genre Fontinalis" (*Rev. Bry.* 1891, p. 83) places this plant in the Section Malacophyllae, distinguished by the very soft and flaccid leaves, plane or very slightly concave, narrow and longly tapering, of which section *F. hypnoides* Hartm. is the type, and in his later work he has, I believe, considered it a river-form of that species. I have examined a specimen from Sweden collected by Indebetou, by whom *F. seriata* as described by Lindberg was originally gathered, and find the leaves much more rigid and decidedly concave, and certainly approaching *F. squamosa*; but it is clear that several different plants have been distributed under the name *seriata* (Arnell, for instance, described it as having the leaves deeply carinate, *Rev. Bry.*, 1882, p. 85); and M. Cardot informs me that he has examined the original specimens on which Lindberg founded his species, and that our plant differs only in having the acumen a little less elongated than in the Scandinavian plant. I feel bound therefore to consider *F. seriata* as distinct from *F. squamosa*, and therefore retain it here as a separate species, without attempting to give any opinion as to its relationship to *F. hypnoides* Hartm., with which its affinity appears to be the closest.

The delicate stems, and flaccid, very narrow, attenuated leaves are the most striking features of the species, and will serve to distinguish it in the field, while under the microscope the plane or scarcely concave leaves afford a critical character, and one which in this genus must be allowed considerable weight. Rev. C. H. Binstead tells me that it has almost the appearance of a confervoid alga when *in situ*, from its extremely delicate, almost filiform growth; it also takes up a good deal of sediment, which the more robust kinds with which it grows do not.

Order XX. CRYPHAEACEAE.

Primary stem creeping, secondary erect, branched laterally and somewhat pinnately, but irregularly. Leaves in many rows, upper cells short and rounded, smooth or slightly papillose:

lower more elongated. No distinct vaginula. Calyptra small, conical, mitriform, rough at apex or throughout. Capsule sessile or sub-sessile, not exserted. Peristome double, single, or none.

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82. **CRYPHAEA** Mohr.

Stems *sub-pinnately branched*, branches unequal, irregular. Leaves imbricated *in several rows, ovate-acuminate, single-nerved*, cells short, *rounded or somewhat oval*, slightly papillose. Inflorescence autoicous. Capsule *immersed or emergent*, oval-oblong, *abruptly narrowed at base*. Calyptra rough, *conical-campanulate*, laciniate at base. Annulus present. Peristome *double ;* outer of 16 linear-lanceolate teeth, confluent at base, inner of 16 narrow, filiform processes from a very short basal membrane.

The plants of this genus grow on the bark of trees, more rarely upon rocks ; the habit is somewhat peculiar, and the sub-sessile, not exserted capsules are characteristic. From the other pleurocarpous mosses with non-exserted fruit it is readily known ; from Fontinalis by the areolation, from Neckera by the not complanate leaves ; while Hedwigia differs in the nerveless, often hyaline-pointed leaves and the absence of peristome.

DERIV.—κρυφαιος (kryphaeos) hidden, in reference to the immersed capsule.

1. **Cryphaea heteromalla** Mohr (*Neckera heteromalla* Hedw. ; *Cryphaea arborea* Lindb., Braithw. Br. M. Fl.) (Tab. XLIX. B.).

Secondary stems erect, *rigid*, somewhat pinnate, with slender branches ; dark or olive green. Leaves *closely imbricated*, especially when dry, spreading when moist, *widely ovate, shortly acuminate, more or less acute or rather obtusely pointed*, concave, excavate at base, margin *entire*, recurved in the lower half ; nerve strong, $\frac{3}{4}$ *length of leaf ;* cells *rounded or oval*, incrassate, slightly papillose, a few at mid-base elongate, narrowly elliptic. Capsules numerous, *on one side of the stem, immersed ;* perichaetial bracts entire, long, acuminate, or obtuse with the nerve excurrent, thin, pale, with narrower, longer cells. Capsule yellowish brown ; lid orange, narrowly conical ; peristome pale green.

Var. β. *aquatilis* C.M. Dark green ; stems *elongated*, less branched, *floating in water ;* leaves *wider, obtusely pointed*, margin almost plane ; perichaetial bracts *denticulate ;* peristome shorter.

HAB. Trunks of trees, frequent ; very rarely on stones. The var. β, Devonshire. Fr. early summer.

The capsules are usually produced in abundance, and the plant is then recognised at a glance; the unilateral, immersed fruit resembling that of no other of our pleurocarpous mosses; the aquatic form (var. β) somewhat resembles Fontinalis in habit, but is, of course, very different in the leaf. Braithwaite (Br. M. Fl., III, 220) maintains this as a separate species, and cites several authorities in support of the view. Limpricht however, who is by no means synthetic in his tendency, keeps it as a variety. The argument that no intermediate forms have been seen is somewhat discounted by the fact that this being an aquatic plant such forms would hardly in the nature of things be looked for. It is in any case a very well marked variety.

The fertile stems in this species are erect, stout, and rigid, and few compared with the short, slender, barren branches, which are rather numerously produced, and it is this somewhat specialised form of the fruiting stems which gives the plant its characteristic appearance when fertile.

Order XXI. NECKERACEAE.

Primary stems creeping, secondary erect, horizontal, or pendulous, pinnately and bipinnately branched. Leaves complanate, ovate-lanceolate or lingulate, obtuse or apiculate, nerveless or thinly nerved, sparingly chlorophyllose, areolation small, rhomboid or linear. Vaginula distinct. Calyptra cucullate, glabrous or hairy. Capsule immersed or emergent, less commonly exserted on a short seta, erect, symmetrical, peristome simple or double.

A natural group of mosses, readily known by their thin and scariose, complanate (apparently but usually not really distichous) leaves with short, often almost geometrically regular, rhomboidal areolation and erect, symmetrical, often immersed capsules. Hookeria and Pterygophyllum differ in the lax areolation and inclined capsules, Plagiothecium in the usually more chlorophyllose leaves of different texture, longly exserted and curved capsules, more perfect inner peristome, and irregular, not pinnate branching.

83. **NECKERA** Hedw.

Growing on trunks of trees or rocks. Secondary stems *pinnately or bipinnately branched*; branches *complanate*, often flagelliform. Leaves *complanate*, smooth or transversely undulate, rounded at apex or suddenly acuminate or apiculate; upper cells *rhomboid or linear, smooth*. Nerve (in the British species) *very short or wanting*. Capsule *immersed or exserted*, erect and symmetrical; calyptra cucullate. Peristome double; inner a *very short basal membrane* with 16 often short processes, *without intermediate cilia*. Autoicous or dioicous.

DERIV.—After Necker, an 18th century botanist and bryologist.

1 { Leaves not undulate.....*4. complanata*
  { Leaves more or less undulate transversely.....2

2 { Capsule immersed ; ls. scarcely undulate when moist.....*1. pennata*
  { Capsule exserted ; ls. distinctly undulate, wet or dry.....3

3 { Robust ; ls. 1-2 lines long, rather bluntly pointed.....*2. crispa*
  { Small ; ls. under one line long, often acuminate.....*3. pumila*

1. Neckera pennata Hedw. (*Fontinalis pennata* L.) (Tab. XLIX. C.).

Secondary stems erect, horizontal, or prostrate, 2–4 inches long, irregularly pinnate, bright or yellowish green ; more robust than *N. complanata*, less so than *N. crispa*. Leaves complanate (leaves and branches all in one plane), spreading, somewhat recurved-cultriform, asymmetrical, ovate-lanceolate, *acute, more or less acuminate, 1–1¼ lines long, strongly transversely undulate when dry*, less so when moist ; margin plane (one margin incurved at base) entire or minutely denticulate above ; nerve extremely faint and short, single or bifid, or wanting ; cells small, *linear-vermicular*, 6–8 times as long as broad, at apex rather shorter and wider, at basal angles shortly quadrate or sub-rectangular, irregular, all thin, pellucid, smooth. Perichaetial bracts long, sheathing, when young convolute and cuspidate, when old more divergent, longly acuminate ; capsule *rather large*, widely oval-oblong, bright reddish brown with an orange, not narrowed mouth, *immersed ;* lid conical, shortly rostellate. Peristome pale, inner imperfect. *Autoicous*.

HAB. Trunks of trees ; nr. Forfar, Scotland. Fr. spring.

A very rare species, only found in the locality mentioned (the Irish record sometimes cited appears to rest on insufficient authority) ; it is common in N. America. The capsules are generally present, and are conspicuous, so that, apart from its size and other points, it is easily recognised, all the other British species having the capsule exserted on a seta. From *N. crispa* it differs also in the usually smaller leaves, more gradually acuminate, and the narrower cells.

2. Neckera crispa Hedw. (*Hypnum crispum* L.) (Tab. XLIX. D.).

Robust, 4–8 inches long, pinnately branched ; branches complanate or depressed and sub-falcate, shining yellowish green, pale brown below. Leaves complanate, *strongly and regularly undulate, 1½–2 lines long*, oblong-lingulate, rounded at the apex and shortly apiculate, denticulate at the summit ; nerve very faint as in the last species ; cells as in the last, but rather wider, especially towards apex. Perichaetial bracts sheathing, con-

volute, the inner narrowly tubular, longly acuminate ; *seta 3–5 lines long*, yellowish, erect or slightly flexuose ; capsule rather small, orange-brown, ovate, narrowed at mouth ; lid shortly and finely rostrate. Peristome pale ; inner membrane very short, processes about half as long as the outer teeth. *Dioicous.*

Var. β. *falcata* Boul. Branches short, *curved*, numerous ; leaves *falcate-depressed, less undulate, often almost smooth, glossy, concave.*

Hab. Calcareous hills, and rocks and tree roots near waterfalls. Not uncommon. The var. β on dry rocks, rare. Fr. rather rare, early summer.

A very fine and beautiful species, acquiring a silky gloss from the regular undulations of the leaves. It can hardly be confused with any other species. *Hylocomium rugosum* inhabits similar localities and has a slight resemblance to it, but the leaves are longly acuminate, and their arrangement quite different.

The var. *falcata* has a very distinct appearance, but is perhaps rather a form than a permanent variety, as among typical plants a stem or branch may here and there often be found with the characters of the variety.

3. Neckera pumila Hedw. (Tab. XLIX. E.).

Slender, pinnate or bipinnate, erect or depressed, *dull shining green*, 1–3 inches long ; branches often flagelliform. Leaves spreading and recurved-cultriform, *variously acute and acuminate, less than 1 line in length, transversely undulate when dry* but often very faintly, denticulate at apex, one basal margin often widely incurved, the other, or both, *narrowly reflexed ;* nerve usually double, very faint, about ¼ the length of the leaf ; areolation as in the last but smaller. Perichaetia *on the under side of the stems*, the bracts convolute, shorter than in the last ; seta yellow, *very short* (*1–2 lines*), often hardly exceeding the perichaetial bracts ; capsule small, oval, narrow at the mouth ; lid conical, acutely rostellate. Dioicous.

Var. β. *Philippeana* Milde (*N. Philippeana* B. & S.). *Prostrate*, usually sterile. Leaves *deeply and regularly undulate, abruptly ending in a long flexuose filiform point.*

Hab. Trunks of trees, rarely rocks. The var. β rare. Fr. not common, early summer.

A somewhat variable species, recognised from the previous ones by its slender habit and small leaves ; from the next by the undulate, more acute leaves, and shorter seta ; the undulation of the leaves is often faint, but they are almost always more pointed than in *N. complanata*, of a duller, less yellowish colour, and with the basal margin recurved. The two species, too, usually frequent rather different trees, *N. complanata* being often found on oak and elm, while *N. pumila* is rarely found on these, more usually preferring smooth-barked species, such as beech and young ash. The fruit is not common, but may occasionally be gathered in damp sub-alpine woods.

The var. β is undoubtedly but a form of this species ; it is a very beautiful plant, and in its extreme state the characters are very striking ; but intermediate forms frequently, indeed commonly, occur ; I have, moreover, an exactly similar variation of *N. pennata*, from N. America. The plant is

always prostrate and creeping, and almost always sterile ; I have found it in fruit in Devonshire.

Small, slender ramuli bearing minute leaves are often produced from the upper part of the stem in this species ; but the ordinary branches are rarely flagelliform as in the next.

4. Neckera complanata Huebn. (*Hypnum complanatum* L.) (Tab. XLIX. F.).

Resembling *N. pumila*, but usually in larger, denser tufts, *yellowish green ;* 2–4 inches long, somewhat regularly pinnate, branches complanate, often flagelliform. Leaves *not undulate*, oblong-cultriform, *usually rounded at the apex and shortly apiculate*, less commonly acute or shortly acuminate, complanate, often, especially at the tip of the stem and branches, deflexed on each side and somewhat falcate ; margin with one wing inflexed at base, *otherwise plane*, faintly denticulate at apex ; *nerve double*, very short and faint, or wanting ; cells *narrowly vermicular* throughout the greater part of the leaf, at summit wider and shorter, rhomboidal ; at basal angles quadrate-oval, yellowish. Perichaetia *on the side of the stem ; seta 4–5 lines long, yellow ;* capsule oval or elliptic-oblong, narrowed at the mouth, *pale, orange-brown*, small ; lid subulate-rostrate, usually oblique ; peristome teeth pale, narrow. Dioicous.

Var. *β. tenella* Schp. *Extremely slender*, leaves *very much smaller.*

HAB. Trunks of trees, banks and rocks. Common. The var. *β* rare ; nr. Ladbrook, Warwick (*Bagnall*) ; Blakesley, Northamptonshire. Fruit rare, spring.

The commonest species of the genus, readily known by its leaves being smooth, not undulate. It is most like *Homalia trichomanoides*, but that plant has the leaves more regularly depressed on each side of the stem and less complanate, the cells wider and the nerve single ; besides which it is autoicous and usually fertile.

N. complanata varies with the leaves more distant, the stems looser and more elongated, and on the other hand with the stems shorter and more compactly tufted, the leaves much crowded ; in the latter form the branches are less frequently flagelliform. The var. *tenella* is exceedingly slender, almost minute, and may perhaps be looked upon as a stunted form with all the branches reduced to the flagelliform character. The flagella are sometimes so numerous in the typical plant as to give the tufts a very marked appearance.

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84. HOMALIA Brid.

(Omalia *B. & S.*, nonnull. auct.).

Habit and leaf structure of Neckera. Seta *elongate ;* capsule erect or sub-erect ; peristome more developed, *the basal membrane*

of the inner one-third the height of the teeth, processes reaching as high as the outer teeth ; cilia sometimes present, rudimentary. Inflorescence autoicous.

DERIV.—ὁμαλια (homalia) flattened, from the expanded or complanate leaves.

1. Homalia trichomanoides B. & S. (*Hypnum trichomanoides* Schreb.) (Tab. XLIX. G.).

In large loose patches, pale shining yellowish green ; secondary stems slender, *flexuose ;* sparingly, *hardly pinnately branched*, the branches not complanate, often curved ; leaves sub-distichous, *depressed on each side of the stem*, oblong-cultriform, *rounded at apex and shortly apiculate*, one margin incurved at base, elsewhere plane ; minutely denticulate above the middle, *more strongly at apex ;* nerve faint, *single*, reaching above half-way ; areolation *narrowly rhomboid*, at apex shorter and wider, hardly longer than broad. Seta *deep red*, ¾–1 *inch long*, slender, flexuose ; capsule *dark reddish brown*, oblong with a distinct tapering neck, *contracted below the mouth when dry*, erect or frequently inclined and slightly curved ; lid longly rostrate ; peristome long. *Autoicous*.

HAB. Trunks of trees and rocks in shady situations, common. Fr. early spring.

Easily known from *Neckera complanata*, which it most resembles, by the characters detailed under that species. Both are very like some species of Hepaticae, such as *Diplophyllum albicans*, in general appearance.

ORDER XXII. HOOKERIACEAE.

Plants of soft, rather succulent texture, stems slightly divided. Leaves in several rows or complanate, areolation smooth, thin, pellucid, often wide and hexagonal. Perichaetial branch very small, few-leaved. Calyptra conical, mitriform, lobed or laciniate, or almost entire. Capsule erect or cernuous, exserted, on a smooth or rough seta. Peristome double, well developed.

The texture and cell-structure in the plants included under this Order, with the structural details mentioned above, render them a natural group, distinct from all the other pleurocarpous mosses. The three British species, belonging to three genera, are all widely distinct from one another as well as from the plants of the neighbouring Orders. Each of them, moreover, is the sole European representative of its genus, the bulk of the species being tropical mosses.

85. **DALTONIA** Hook. &. Tayl.

Leaves *in many rows, singly nerved,* narrowly lanceolate, distinctly *bordered. Seta and capsule papillose.* Calyptra *longly laciniate at base ;* annulus none.

DERIV.—After the Rev. James Dalton, a British botanist and bryologist.

1. **Daltonia splachnoides** Hook. & Tayl. (*Neckera splachnoides* Sm.) (Tab. XLIX. H.).

Stems short, ¼–½ inch high, densely tufted, dark green. Leaves closely imbricated, *linear-lanceolate,* acuminate, keeled, entire ; *nerve ceasing below the apex ;* cells small, *elliptic-rhomboid, or linear,* very variable even in different parts of the same leaf, the marginal in several rows narrow-linear, forming a *distinct, yellowish, thickened border.* Seta red, *papillose,* about 3 lines in length ; capsule small, *erect,* oval-oblong, with a short neck, *papillose :* lid yellowish, longly rostrate. Calyptra hardly reaching below the lid, conical, *strongly fringed or ciliate at base ;* peristome teeth yellowish, linear-lanceolate ; inner of 16 narrow processes, without a basal membrane. Autoicous and synoicous.

HAB. Shady rocks or trees in sub-alpine regions. Very rare ; in two or three localities in Ireland. Fr. autumn.

One of our most distinct species, being unique among the pleurocarpous mosses in its bordered leaves with long nerve and small narrow cells, as also in the papillose capsule.

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86. **HOOKERIA** Tayl.

Stems *procumbent ;* leaves *widely ovate or lingulate, two-nerved,* often bordered, *complanate,* areolation *large, soft.* Calyptra *shortly lobed* at the base. Capsule *inclined,* inner peristome with a basal membrane.

DERIV.—After Sir W. J. Hooker, author of the "British Flora," etc.

1. **Hookeria laete-virens** Hook. & Tayl. (Tab. XLIX. I.).

Stems procumbent, sub-pinnately branched ; branches complanate ; deep green, *very soft and flaccid.* Leaves large, complanate, *rather distant,* widely spreading, oval-oblong, *abruptly and sharply acuminate,* thin and pellucid, when dry flaccid, *shrinking, and somewhat undulate, finely denticulate at apex ;* with *two distinct, narrow nerves,* reaching three-fourths the length

of the leaf, divergent from the base ; cells widely and shortly hexagonal, about 1½–2 times as long as wide, *20-25 μ in diameter*, laxer at base, thin-walled ; the marginal in 2–4 rows of narrow-linear cells, forming *a narrow but distinct border*. Seta about 1 inch long, reddish, smooth. Capsule small, horizontal or sub-pendulous, elliptical, smooth ; lid rostrate. Peristome red, the inner yellow ; basal membrane one-third the height of the teeth. Autoicous.

Hab. Damp rocks by rivulets, etc., very rare. Penzance ; S.W. Ireland. Fr. autumn.

A very rare and pretty species, known at once by its soft, rather distant, spreading leaves, with long double nerve, smaller areolation, and distinct border, from *Pterygophyllum lucens*, and indeed from all our species.

87. PTERYGOPHYLLUM Brid.

Leaves *large, ovate, nerveless, complanate, entire, succulent.* Cells *large, hexagonal.* Fruiting characters as in Hookeria.

Deriv.—*πτερυγο-*(pterygo) wing or feather, and *φυλλον* (phyllon) a leaf. From the pinnate arrangement of the leaves.

1. Pterygophyllum lucens Brid. (*Hypnum lucens* L.) (Tab. XLIX. J.).

In irregular patches, pale glaucous or bright green, glossy ; stems procumbent, irregularly branched. Leaves rather closely imbricated, complanate, *when dry little altered, large*, widely oval, *obtuse, entire, nerveless ;* cells *very large*, hexagonal, 2–3 times as long as broad, *50–60 μ in width*, thin-walled, *the marginal hardly distinct.* Seta and capsule reddish, *succulent.* Seta smooth, ½–1 inch high ; capsule horizontal or sub-pendulous, short, oval ; lid long-beaked ; peristome red. Autoicous.

Hab. Sandy ground, stones, etc., in moist situations ; frequent, especially in sub-alpine districts. Fr. late summer.

A very beautiful and distinct plant, not likely to be mistaken for any other ; the large, glossy, obtuse, complanate leaves, not undulate, nerveless, and laxly areolate are quite different from those of any other species. The cells are so large as to be easily visible with the lens. The seta is of a remarkably thick and succulent texture. A very striking form occurs in springs and bogs, in large dense tufts with the stems all erect.

ORDER XXIII. LEUCODONTACEAE.

Stems irregularly branched, not pinnate. Leaves in several rows; areolation short, rounded-oval, almost always smooth. Nerve single, double, or absent. Capsule symmetrical. Peristome double, rarely single. Calyptra cucullate. Seta smooth.

The genera united under this Order agree in the areolation of their leaves, short and often rounded or oval at least in the upper half, and smooth, not papillose; thus differing from the Orthotheciaceae and Hypnaceae on the one hand and from the Leskeaceae on the other. From the Neckeraceae they differ in the non-complanate leaves and different areolation, from Cryphaeaceae in the cucullate calyptra and exserted capsule, from Hookeriaceae in the cucullate calyptra and very different cells.

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88. **LEUCODON** Schwaeg.

Secondary stems erect or arcuate, moderately robust. Leaves *closely imbricated, rendering the branches julaceous when dry; longitudinally plicate, nerveless.* Upper areolation *elliptic.* Perichaetial bracts long, sheathing. Annulus present; peristome *single,* teeth irregular, short, fugacious. Calyptra reaching to the base of the capsule.

DERIV.—λευκ-(leuk) white, and ὀδων (odōn) a tooth. From the pale peristome.

1. Leucodon sciuroides Schwaeg. (*Hypnum sciuroides* L.) (Tab. XLIX. K.).

Primary stem slender, creeping, giving off numerous erect, secondary stems, which are simple or slightly branched, *cuspidate,* straight, *terete and julaceous,* with the leaves closely imbricated all round, or frequently arcuate with the leaves slightly secund and homomallous; 1–2 inches high, rarely more. Leaves *crowded,* dark green, erecto-patent, when dry erect and appressed, 1–1½ lines long, *cordate-ovate, narrowed above and then rapidly tapering to a narrow acumen,* concave, *longitudinally plicate;* margin plane, entire, or minutely denticulate in the acumen; *nerve none.* Cells in the upper part *very small, oval,* longer and elongate-elliptic in the acumen; *at mid-base narrow-linear,* extending about half-way up the leaf and gradually passing into the oval ones; *at margins in the lower half of the leaf rounded, dot-like,* forming a broad band on each side, which is widest at base. Seta about half-an-inch long; capsule elliptic-oblong, brown, lid conical. Dioicous.

Var. *β. morensis* B. & S. (*Hypnum morense* Schleich.). Secondary stems and branches tall, *thick, turgid;* leaves wider; perichaetial bracts longer; capsule *cylindrical.*

HAB.- Trunks of trees, more rarely on rocks. The var. *β* very rare. Fruit very rare, spring.

Readily identified by the terete, often curved, usually cuspidate branches and stems, with plicate, nerveless leaves. *Camptothecium sericeum* somewhat resembles its more slender forms, but the leaves of that species are longer and narrower, nerved, more deeply plicate, with longer, narrower cells. The lower leaves are often shorter and more spreading, even when dry.

The var. *morensis* is the most frequent form in the Mediterranean region; forms somewhat approaching it may not unfrequently be seen; I have specimens from Craig Chailleach, but I am not aware that fertile plants have been found in this country.

The tips of the stems often produce numerous, gemmiform branchlets, which are short, filiform, and minute-leaved, sometimes occurring in such quantities as to deform the plant.

A slender form with the branches long and arcuate, and the leaves decidedly falcato-secund, is the *forma falcata* Boul.

L. brachypus, a North American plant, which might occur here, closely resembles *L. sciuroides* in vegetative characters, but the capsules are immersed. It has the leaves somewhat less finely acuminate, and more distinctly denticulate at apex. *L. immersus* Lindb. from the Caucasus appears to be a similar plant.

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89. **PTEROGONIUM** Swartz.

Primary stems creeping, stoloniform, giving rise to *erect, sub-dendroid* secondary stems, unbranched at the base, *with numerous, crowded branches at the summit, all turned to one side and curved.* Leaves crowded, imbricated all round the stems and branches, *ovate-acuminate,* faintly nerved. Upper areolation narrowly elliptical or oval. Peristome double. Calyptra sparingly hairy.

DERIV.—*πτερο-*(ptero) wing, and *γονος* (gonos) a shoot. Probably from the axillary perichaetial branches.

1. Pterogonium gracile Swartz (*Hypnum gracile* Dill.; *Pterogonium ornithopodioides* Lindb., Braithw. Br. M. Fl.) (Tab. XLIX. L.).

In wide, close patches, dark green or brownish. Secondary stems very slender, usually bare below, 1–2 inches high, above with *numerous clustered branches, which are curved to one side, slender, julaceous when dry* with the leaves closely imbricated and appressed, obtuse, or elongated and flagelliform, often re-branched. Leaves *widely cordate-ovate,* rapidly and sharply

contracted to *a longer or shorter acumen*, the uppermost and those of the smaller branches less suddenly and more shortly and widely acuminate, or acute only; all *concave*, excavate at base, *not plicate*, densely crowded, when moist spreading, when dry *closely appressed*, rendering the branches julaceous; *sharply dentate* towards apex, at back above sparsely scabrous with acute ascending papillae; margin usually plane; nerve very faint and short, sometimes quite wanting; either double or single and forked above, hardly reaching half-way. *Median and apical cells narrowly elliptical-vermicular*, longer at base; cells of basal wings in many rows short, wider, rounded-quadrate, becoming oval above, then elliptical-rhomboid, finally becoming uniform with those of the median part; in the shorter branch-leaves the areolation is much shorter, wider, and more uniformly oval-rhomboid, narrowly elliptical only at base. Capsule on a long seta, erect or slightly curved, sub-cylindric; lid conical, rather obtuse; peristome pale yellow, inner of short processes without cilia on a narrow basal membrane. Dioicous.

Var. β. *harlecense* D. A. Jones in Journ. of Bot. 1917, 267. Very *slender*, branches frequently *flagelliform;* leaves *minute*, *more acuminate*, cells slightly larger.

HAB. Rocks and tree-trunks, mostly in sub-alpine districts. Frequent. The var. β rare; North Wales; Perthshire. Fruit rare, autumn.

The curved cylindrical branches all pointing the same way, and very terete and julaceous, especially when dry, give this moss a somewhat peculiar and very characteristic look. The branches vary considerably in slenderness, sometimes becoming almost filiform when dry, but always exhibiting a marked difference of aspect between the moist and the dry state, so as hardly to look like the same plant. It has some resemblance to *Pterigynandrum filiforme*, but that is a more delicate plant with the stems less dendroid, the branches more slender, the leaves much smaller and less pointed, and the areolation papillose. *Eurhynchium circinatum* is also somewhat like it, but with shorter, more equal branches, and the nerve strong and well defined.

The scabrous denticulations on the back of the leaf, most noticeable in the upper leaves of a branch, are not of the nature of papillae as in Pterigynandrum and other genera of Leskeaceae, but are more akin to the spines on the backs of the leaves of Catharinea, etc., on a smaller scale. Boulay unites this species with Isothecium (some species of which have the leaves similarly scabrous), and with some reason; the areolation is however different; and the close imbrication of the leaves is a distinctive feature of this plant.

The var. β is a marked form which seems fairly constant in its characters; much more slender than the type. The var. *capense* C.M. from the Cape of Good Hope has similarly—but much more longly—flagelliform branches, but is a robust plant, more so perhaps than the type.

90. **HABRODON** Schp.

Slender, very small, with creeping stems and sub-erect, *filiform* branches. Leaves *minute,* ovate-acuminate, *entire, nerveless.* Cells *elliptic-rounded,* smooth. Capsule minute, oblong-cylindrical, erect ; annulus broad ; peristome *single, arising below the mouth of the capsule.* Dioicous.

DERIV.—ἁβρο-(habro) delicate, and ὀδων (odon) a tooth. Alluding to the peristome.

1. **Habrodon Notarisii** Schp. (*H. perpusillus* Lindb., Braithw. Br. M. Fl.) (Tab. XLIX. M.).

Minute, very slender, almost prostrate, the branches *filiform, all pointing one way,* hardly 2 lines long. Leaves minute, ovate-cordate or ovate-lanceolate, longly acuminate, hardly excavate at base, not concave, closely imbricated and appressed when dry, spreading when moist ; margin plane, entire or slightly crenulate ; nerve *none ;* cells small, oval or elliptical, at margin shorter, at mid-base more elongated, towards basal margin short, rounded-quadrate, in many rows. Seta short, capsule minute, narrowly oblong ; lid conical. Dioicous.

HAB. On the bark of trees, chiefly in sub-alpine districts ; rare. Fruit very rare, spring.

The most minute and delicate species of the present Order ; differing from the minute species of Amblystegium in the branches more terete and julaceous when dry from the closely set, appressed leaves ; and in the shorter oval cells.

91. **HELICODONTIUM** Schwaeg.

(Myrinia Schp., *Handb. Ed. I.*)

Stems *creeping, sparingly and irregularly branched.* Leaves oval, *entire,* shortly nerved. Areolation *rhomboid,* quadrate at angles, smooth. Annulus none. Peristome *double.*

DERIV.—ἑλιξ (hĕlix) twisting, and ὀδοντ-(odont) tooth, from the peristome, curling inwards when dry.

1. **Helicodontium pulvinatum** Lindb. (*Leskea pulvinata* Wahl. ; *Myrinia pulvinata* Schp., *Handb. Ed. I., et plur. auct.*) (Tab. XLIX. N.).

In soft, dense, deep green tufts, stems prostrate with erect or slightly curved, *slender* branches about ½-inch in height. Branches flexuose, somewhat obtuse, *sub-julaceous when dry,*

Leaves small, spreading or sub-secund, *appressed and imbricated when dry, widely oval,* or bluntly apiculate or acute, margin plane, entire; nerve *very faint, single,* reaching about ⅓ up the leaf. Cells rather large, *widely oval-rhomboid,* at basal wings *quadrate-rectangular,* all wide, *smooth.* Seta about three lines long; capsule oval-oblong, slightly curved and unequal; lid conical; outer peristome pale, inner *deep yellow. Autoicous.*

HAB. About the roots of trees near water. Very rare. Fr. summer.

Resembling slender forms of *Leskea polycarpa,* but differing in the smaller, less secund leaves with faint nerve and smooth cells. The two species grow in similar localities, and are occasionally found together; the present plant may then be known by the more slender habit, darker colour, and—being generally abundantly fertile—by the smaller, shorter capsules.

It appears to be necessary, as pointed out by Lindberg, to suppress the more widely known generic name Myrinia, in favour of Schwaegrichen's earlier genus, to which our species seems clearly to belong.

92. **ANTITRICHIA** Brid.

Secondary stems *elongated,* procumbent or pendulous, *more or less pinnately branched;* leaves ovate-acuminate, denticulate above, *single-nerved.* Capsule on a straight or flexuose seta, elliptical; annulus narrow, calyptra cucullate, not covering the whole capsule; peristome *double,* inner of 16 filiform, fragile processes, *without a basal membrane.* Dioicous.

DERIV.—ἀντι-(anti) opposite, and τριχια (trichia) filaments. From the erroneous supposition that the processes were opposite to, not alternate with the outer teeth.

1. **Antitrichia curtipendula** Brid. (*Hypnum curtipendulum* L.) (Tab. L. A.).

Secondary stems *long, 4–12 inches, robust, more or less regularly pinnate,* in loose tufts or masses, olive-green or yellowish. Leaves densely imbricated, spreading when moist, sub-erect when dry, almost always falcato-secund, *widely ovate from a broad insertion, gradually acuminate* to a more or less tapering point, *large. 1–1½ lines long, irregularly plicate,* slightly decurrent, margin strongly revolute from base to near summit, *sharply dentate at apex,* the teeth strong and sometimes recurved, especially at the extreme tip; nerve wide, *reaching ¾ of the length of the leaf,* at base very broad, where it usually sends out one or two short, faint, lateral branches on each side. Areolation *very small, elliptical with a sigmoid curve,* smooth or slightly roughened at back, at mid-base

rather longer and narrower, at basal margins short, irregularly rounded, in numerous rows. Perichaetial bracts long, *sheathing*. Seta about half-an-inch long, *curved or flexuose;* capsule large, elliptical, reddish brown, paler at first, somewhat narrowed at the often slightly oblique mouth; calyptra smooth, with a long subulate beak, reaching to about the middle of the capsule; lid shortly rostellate. Peristome short, pale yellow.

HAB. Rocks and trees, principally in mountainous districts; not uncommon. Fr. rare, spring.

This fine species somewhat resembles *Hylocomium loreum* in appearance, but the leaves are more densely imbricated with much shorter acumen, giving a very different appearance to the stem when closely examined. In some of its short, slender states it simulates the very rare *Hyl. pyrenaicum*, which, however, is a less robust and rigid plant with numerous paraphyllia, and less crowded leaves, which are more abruptly acuminate, less revolute at margin, with looser basal areolation, and generally longer cells; it is also quite wanting in the peculiar apical dentation of the present plant, which frequently exhibits a double or triple recurved tooth at the extreme apex, in the form of a grapnel. This, however, is not always present, and the apex of the leaf is, moreover, rather fragile and frequently lost.

The capsules are, when present, produced in considerable numbers towards the summit of the stems.

This plant grows nowhere, perhaps, more finely in our islands than in Wistman's Wood, Dartmoor, where it clothes the limbs of the old and stunted oaks with large masses, hanging down to the length of a foot or more, and producing fruit in abundance.

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93. **POROTRICHUM** Brid.

(Thamnium *B. & S.*, plur. auct.)

Primary stem creeping, stoloniform; secondary stems erect (rarely depressed), *dendroid, tall and robust*, divided above, *with numerous curved branches more or less turned to one side*. Leaves oval-oblong, of solid texture, *strongly single-nerved, toothed*. Cells *oval or rounded*, small and short. Capsule *inclined and somewhat arcuate*. Annulus present. Peristome *perfect*, inner with a wide basal membrane, and with 3 appendiculate cilia between the processes.

The usual name Thamnium (Bry. Eur.), of this genus, had been previously appropriated by more than one author, being applied to a genus of lichens in 1799 (and subsequently to two genera of flowering plants); it must therefore be erased from our bryological nomenclature. The name Porotrichum was first applied by Bridel (as a sub-genus of Climacium) to the south American species, *P. longirostrum* (*Hypnum longirostrum* C.M.), with which the present species, according to Mitten, is congeneric.

On account of the perfect development of the peristome, the genus has been by most writers placed among the Hypnaceae, but the nature of the areolation renders its position there anomalous, and a perfect peristome is found in other genera which are by the same authors separated from that Order ; it appears more logical, therefore, to include it in the present Order, to which by the nature of its leaves and areolation it properly belongs.

DERIV.—*πορο-*(poro) pore, perforation, and *τριχ-*(trich) hair. From the perforated processes of the inner peristome.

{ Ls. narrower at insertion than above, more or less ovate.....*1. alopecurum*
Ls. widest at insertion ; branch ls. narrow, ligulate ; nerve wide *2. angustifolium*

1. Porotrichum alopecurum Mitt. (*Hypnum alopecurum* L. ; *Thamnium alopecurum* B. & S., plur. auct.) (Tab. L. B.).

Secondary stems robust, erect or sub-pendulous, 3–8 inches long ; dark brown, *rigid and unbranched at base*, above divided into numerous branches forming a dark dull green terminal head ; branches more or less turned to one side, frequently somewhat complanate, slender, short and curved or longer, straight and flagelliform ; lower stem-leaves scale-like, increasing in size upwards, *broadly triangular and scariose*, the upper more chlorophyllose ; branch-leaves *narrow, elliptic-oblong, narrowed at the insertion, sharply and coarsely toothed*, especially above, acute but not acuminate, margin *plane ;* all *strongly nerved to just below the apex ;* somewhat spreading when moist, loosely imbricated when dry, not twisted, but often incurved at apex so that the branches appear somewhat catenulate. Areolation of stem-leaves *shortly elliptic*, somewhat elongated and enlarged at base ; of branch-leaves *rounded or sub-quadrate*, a little elongated at the very base. Perichaetial bracts oblong-acuminate, the points divergent. Seta short, about half-an-inch, curved at the summit, so that the capsule is *inclined or horizontal ;* calyptra large ; lid *longly rostrate, oblique ;* capsule oblong, *curved*, reddish ; peristome large, pale red. Dioicous.

Var. *β. aridulum* D. A. Jones in Journ. of Bot, 1917, p. 266. In *low dense tufts*, not dendroid, resembling *Eurhynchium myosuroides* in habit and colour. Stem-leaves *very small*, nerve *shorter*, sometimes wanting. Branch-leaves *small ; cells very little elongate at base.*

HAB. Shady woods, and rocks by waterfalls. Common. Fruit not common, autumn. The var. *β* on dry siliceous rocks, Harlech (*D. A. Jones*).

This fine moss is usually recognisable at once by its dendroid stems, the lower part black, with silvery triangular leaves ; the terrestrial form differs considerably from the rupestral one ; in the former the branches are not

complanate, usually curved and rather robust with the leaves more spreading ; in the latter they are generally distinctly complanate, straighter, more slender and flagelliform, with smaller more appressed leaves. The former is more rarely found in fruit, but the capsules when present seem to be larger and better developed. Numerous setae are as a rule produced on each stem, and all from the summit, often very close together.

The nerve is somewhat channelled above at back and sparingly toothed. It is strong, but never occupies any considerable proportion of the width of the leaf as in the next species.

A slender, sub-aquatic form occurs, very closely resembling *Eurh. myosuroides* var. *rivulare*, scarcely indeed distinguishable in the field except by the much stronger nerve ; in the latter plant the leaves are usually straighter and more rigid when dry, not incurved and catenulate.

P. alopecurum occasionally becomes detached from the soil and continues to grow in the form of a sub-spherical detached mass, readily blown about by the wind.

The var. β is very marked in size and habit, but may partly be produced by the dry habitat.

2. Porotrichum angustifolium Dixon (*Thamnium angustifolium* Holt, Journ. of Bot., 1886, p. 65) (Tab. L. C.).

Very small ; leaves *much narrower* (those of the branches *ligulate*), *widest at the insertion*, more strongly toothed ; nerve *very wide* and thick, *occupying* $\frac{1}{3}$ *width of leaf at base or more ;* cells *more elongated and narrower*, especially at base and near the nerve ; upper somewhat larger than in the last, irregularly oval. Fruit unknown.

Hab. By calcareous springs, "Raven's Dale," Derbyshire (*Holt*). Ireland (*Shepley*).

Quite distinct from the last species, and only known at present from the two above localities. The leaves are always widest at, not above, the base, the nerve much broader, the upper cells larger.

"Limestone ravine, Cressbrook, near Monsal Dale," would be a more accurate description of the English locality, there being no Raven's Dale properly so called. This species has never been found outside Britain. For its discovery in Ireland see Irish Naturalist, xxxiii, 45.

Order XXIV. LESKEACEAE.

Mosses of varying habit, differing from Leucodontaceae in the cells papillose, from Hypnaceae in the short, rhomboid or sub-rounded cells. Capsule usually erect, but frequently curved. Peristome hypnoid, variously developed ; calyptra cucullate.

94. **MYURELLA** B. & S.

Plants small, *slender*, irregularly branched, *glaucous green ; branches julaceous* from the regularly imbricated, *roundish, concave leaves ;* nerve *double, very faint ;* cells lax, *hexagonal-rhomboid*, lightly or strongly papillose. Dioicous. Calyptra minute. Capsule *small*, erect or sub-inclined ; annulus present. Peristome *perfect*, inner with cilia. Dioicous.

A genus of very pretty plants of most distinct habit, the stems and branches extremely slender, fragile, and regularly julaceous, of a pale glaucous green, inhabiting mountain rocks.

DERIV.—Diminutive of Latin *myurus*, a mouse-tail, from the form of the branches.

{Ls. closely imbricate, obtuse or very shortly apiculate.....*1. julacea*
{Ls. spreading, more distant, usually with longish apiculus.....*2. apiculata*

1. Myurella julacea B. & S. (*Hypnum julaceum* Vill.) (Tab. L. D.).

Very slender ; stems slightly branched ; *pale whitish green*, reddish below ; branches *filiform*, rather obtuse, fragile ; leaves *very densely imbricated, concave, rounded, obtuse or minutely apiculate*, faintly denticulate at margin, nerve double or forked, short, indistinct ; cells irregularly oval-rhomboid, pellucid ; at base laxer, sub-rectangular. Seta slender, capsule erect or inclined, elliptic-oblong ; lid conical ; peristome yellowish.

Var. *β. scabrifolia* Lindb. Looser and more straggling ; leaves *more strongly papillose, less closely imbricated, strongly hispid-denticulate at margin*, especially towards base, *distinctly apiculate.*

HAB. Mountain rocks, rare. The var. *β*, Ben Lawers ; Craig Chailleach. Fr. very rare, summer.

Differs from the next species in the more closely imbricated, not spreading leaves, with a less distinct apiculus or obtuse ; the var. *β* however has a most perplexing resemblance to *M. apiculata*, and even more to the continental and N. American *M. Careyana* Sull. The former differs in the less toothed margin, smoother cells and yellowish green colour ; the latter is sometimes almost indistinguishable except by the nature and position of its papillae, which are large and single in the middle of the face of the cell, while in our two species they are smaller, and are formed upon the end walls where two cells meet, as in Bartramia. The difference is precisely the same that obtains between the papillae of *Pseudoleskea atrovirens* and *P. patens*.

The papillae are usually very indistinct in the type, and are most conspicuous at the back of the upper leaves.

2. Myurella apiculata B. & S. (*Isothecium apiculatum* Huebn. ; *Myurella tenerrima* Lindb., Braithw. Br. M. Fl.) (Tab. L. E.)

Resembles the last species. Yellowish green, less white and glaucous. Leaves *more distant, spreading when moist and less*

appressed when dry, ending in *an abrupt apiculus*, which is often rather long and flexuose, and recurved.

HAB. In similar situations ; very rare. Ben Lawers ; Craig Chailleach. Fr. summer.

Easily distinguished from *M. julacea* type by the characters italicised ; from its var. *β* by the characters pointed out under that plant.

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95. **LESKEA** Hedw.

Primary stems creeping, *not stoloniform*, irregularly divided, the divisions procumbent, with numerous erect or spreading branches. *Leaves of stems and branches uniform, ovate-lanceolate, nerve single.* Capsule *erect*, symmetrical or slightly curved, more or less cylindric ; *seta arising from the primary stem.* Peristome double ; inner with the basal membrane short or none, cilia absent.

A genus of mosses for the most part slender and of soft texture, at any rate in the European species, though some typical species are more robust. They differ from Anomodon principally in the position of the fruit.

DERIV.—After Leske, a professor at Leipzig.

{ Ls. ovate-lanceolate, sub-acute, nerve ceasing below apex.....*1. polycarpa*
{ Ls. narrowly acuminate, nerve strong, reaching apex.....*2. nervosa*

1. **Leskea polycarpa** Ehrh. (Tab. L. F.).

Slender, stems prostrate, pinnately or bipinnately branched ; branches short, erect, curved, or prostrate ; bright or dull green in somewhat intricate close patches, hardly ½-inch high ; stems 1-2 inches long, soft in texture. Leaves *erecto-patent or secund, loosely incumbent when dry*, small, less than ½-line in length, *ovate-lanceolate, shortly pointed or obtuse, soft*, entire, margin slightly recurved in the lower half, nerve *vanishing considerably below apex*, strong below ; areolation *hexagonal*, pellucid, thin-walled, more or less papillose at back, *almost uniform throughout the leaf*, at base a little enlarged and more rectangular. Seta about ½-inch long, reddish ; capsule *cylindric, narrow, tapering at base*, 1–1½ lines long, erect, straight or slightly curved, finally reddish brown, lightly contracted below the mouth when dry ; lid elongate-conical, rather acute ; calyptra whitish ; peristome teeth long, whitish, connivent when dry, processes as long as the teeth. *Autoicous.*

HAB. At the foot of trees by water, common. Fr. summer.

Leskea polycarpa usually fruits abundantly, and may thus be easily recognised from all the preceding species of pleurocarpous mosses, none of which, except perhaps *Leucodon sciuroides*, which is dioicous and rarely fruits, have such narrow, elongated capsules. The short, scarcely acuminate leaves, almost always slightly secund, give it a characteristic appearance. It is a difficult plant to gather in good condition, being often much coated with muddy deposit. The small, whitish calyptra gives it somewhat the appearance, when the fruit is young, of *Amblystegium serpens*. Slender forms occur occasionally, as also more robust ones (var. *paludosa* Schp.), but as a rule it is not a variable plant.

The peristome is a very pretty object when dry, the outer teeth being gracefully incurved, while the processes remain erect.

Helicodontium pulvinatum has a much shorter capsule, short nerve, etc.

2. Leskea nervosa Myrin (*Pterogonium nervosum* Schwaeg.) (Tab. L. G.).

Very slender, stems irregularly branched and re-branched; branches *filiform*, straight, often with crowded gemmiform axillary branchlets at the apex; bright or brownish green; leaves *densely imbricated*, erecto-patent, *closely appressed when dry so that the branches are terete, very small, widely acute, rapidly tapering to a long, finely acuminate point;* margin recurved below, *entire;* nerve vanishing in the acumen *near apex;* median cells irregularly oval, marginal shorter, rounded, or transversely elliptic, all small, incrassate, lightly papillose, *hardly altered at base*. Seta short; capsule erect, sub-cylindric, small; peristome small, processes shorter than the teeth. *Dioicous*.

HAB. Trunks of trees and rocks in sub-alpine districts. Very rare; Ben Lawers. Fruiting very rarely, in summer.

A much more delicate plant than the last, with filiform stems and branches and very differently shaped leaves. *Pseudoleskea atrovirens* differs in the colour, the wider and larger, secund leaves; *P. patens* in the larger, less crowded, more shortly pointed leaves; *P. striata* in the smooth, denticulate leaves with more elongated cells; *Anomodon longifolius* in the more elongated, straggling habit, and the leaves denticulate, much more loosely imbricated and more distant; all the other species with which it might be confused differ in the elongated areolation or shorter nerve.

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96. ANOMODON Hook. & Tayl.

Primary stems *stoloniform*, with very small leaves differing from those of the secondary stems and branches; secondary stems erect or ascending, *irregularly branched*. Leaves ovate or lanceolate, *single-nerved;* cells more or less rounded, *highly papillose on both sides*. Fruit produced *on the erect secondary stems*. Capsule *erect*, symmetrical. Cilia of inner peristome none or rudimentary. Dioicous.

DERIV.—ἀ-(a) not, νομο-(nomo) law, rule, ὀδων (odōn) tooth; "having an abnormal peristome," from the erroneous supposition that the processes arose from between the outer teeth, and not from an inner membrane.

1 { Ls. narrow, acuminate ..... 1. *longifolius*
  { Ls. more or less obtuse or apiculate 2

2 { Slender; ls. about ½ line, apiculate, often with a few distinct teeth at apex ..... 2. *attenuatus*
  { Robust; ls. about 1 line, entire or minutely serrulate at apex ..... 3. *viticulosus*

1. Anomodon longifolius Hartm. (*Pterigynandrum longifolium* Schleich.) (Tab. L. H.).

Very slender, secondary stems irregularly branched; branches often flagelliform, *filiform;* olive or yellowish green, in dense, wide patches; leaves *very small, lanceolate, gradually tapering to a narrow acuminate point*, erecto-patent from an erect, subsheathing, decurrent base, *loosely incumbent when dry*, not crowded, margin plane, *minutely denticulate above*, nerve pellucid, ceasing below apex; - cells rounded-hexagonal, opaque, *highly papillose*, very slightly enlarged at the base. Seta short, capsule hardly raised above the branches, oblong-cylindric, small; annulus none; peristome small.

HAB. Rocks, etc. Very rare; Scotland; England. Fruit very rare, not found in Britain.

A more slender and delicate plant than the two following, with much more tapering, acute leaves. It bears some resemblance to the most slender forms of *Leskea polycarpa*, or robust forms of *Amblystegium serpens*, but differs from the former in the habitat and much more slender leaf-points; from the latter in the more regular growth, the branches all pointing the same way; from both in the highly papillose decurrent leaves.

2. Anomodon attenuatus Huebn. (*Hypnum attenuatum* Schreb.) (Tab. L. I.).

Intermediate between *A. longifolius* and *A. viticulosus*, and somewhat resembling a miniature form of the latter; irregularly branched and intricate, some branches short and rather obtuse, others elongated and flagelliform, 1 2 inches high; leaves spreading or secund, usually distinctly homomallous when dry, *about ½ line in length, oblong-lanceolate from a widely oval base*, acute and minutely apiculate, at the insertion very narrow, excavate and slightly decurrent; margin plane, minutely crenulate with papillae, at extreme apex *usually with a few teeth;* nerve ceasing below apex, pellucid; cells irregularly hexagonal, opaque,

highly papillose, thin-walled, a few at mid-base pellucid, elongate-rectangular. Seta longer, about ¾-inch; capsule *elevated above the branches;* lid longly beaked; peristome larger than in the last.

HAB. Rocks, etc., in mountainous districts; very rare. Den of Airlie; Alders, Elcho, Perthshire, 1900 (*J. Menzies*). Fruit not found in Britain.

The less tapering leaves distinguish this from the last species, and the small size, flagelliform branches and usually denticulate leaves from the next.

3. Anomodon viticulosus Hook. and Tayl. (*Hypnum viticulosum* L.) (Tab. L. J.).

Secondary stems *long, 2–4 inches, robust,* slightly branched. Plants bright green, dull green when dry, in large loose tufts. Leaves spreading and secund, *crisped when dry and incurved,* undulated at margin, *ligulate-lanceolate from a widely ovate base, large,* above 1 line in length, excavate at base, *obtuse or apiculate at summit,* margin very slightly recurved at base, often on one side only, crenulate-denticulate above; nerve *strong, pellucid,* whitish at back when dry, reaching nearly to apex; cells hexagonal, thin-walled, opaque, highly papillose; the basal median ones pellucid, rectangular. Seta straw-coloured, about ¾-inch long; capsule erect, sometimes slightly curved, cylindric, *1–1½ lines long,* slightly contracted at the mouth; lid conical-rostellate; annulus distinct; peristome yellowish; inner with a very short basal membrane and short irregular processes.

HAB. Roots of trees and old walls, common. Fruit rather rare, spring.

The commonest species of the genus, and the most robust; the leaves of a very marked form, and, a very uncommon feature among pleurocarpous mosses, distinctly crisped when dry. It is indeed a striking moss, and one not likely to be mistaken for any other. When dry it is not at all glossy, and of a very dull green, but upon moistening the leaves at once regain their spreading direction and become of a brighter colour.

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97. LEPTODON Mohr.

Stems from a creeping rhizome, *pinnately branched; stems and branches strongly enrolled when dry.* Leaves *single-nerved, obtuse;* cells *short, oval,* slightly papillose. Capsule exserted on a short seta, erect, symmetrical. Calyptra *hairy,* cucullate. Peristome double, the outer of 16 pale teeth; the inner reduced to a *very short* membrane, rarely with short, rudimentary processes.

DERIV.—λεπτο-(lepto) thin, and ὀδων (odōn) tooth. From the peristome.

1. Leptodon Smithii Mohr (*Hypnum Smithii* Dicks.) (Tab. L. K.).

Bright green, in rather large flat patches. Stems prostrate, 1–2 inches long, rigid, pinnately branched; branches very short, rather obtuse, equal. When dry the stem and branches *roll together in the form of a crosier*, the apical branches especially rolling up almost into a ball. Leaves spreading, when dry erect and somewhat homomallous, small, half a line in length, *cordate-ovate, rounded and obtuse*, entire, *concave*, margin recurved on one side near the base, otherwise plane; nerve wide at base, thin and indistinct, *reaching beyond the middle;* cells *round or very shortly oval*, distinct, the median basal somewhat narrow and elongate-elliptic, 3–5 times as long as broad; all rather incrassate, very slightly papillose. Perichaetial bracts oblong-lanceolate, narrowly acuminate, thin. Seta *very short*. Capsule slightly exserted, oblong, narrowed at the mouth. Lid conical, acuminate; peristome small, pale. Calyptra and vaginula *covered with long hairs*. Dioicous.

HAB. Trees and rocks, principally in the south of England; Wales; Cumberland; I. of Man. Fr. rather rare, spring.

A southern species, which fruits abundantly in the countries about the Mediterranean, but is rather rare with us and usually barren. When dry the closely rolled up branches have a very peculiar appearance, unlike that of any other of our mosses; the wide, obtuse leaves with a single nerve are also very characteristic.

98. PTERIGYNANDRUM Hedw.

Primary stem creeping, stoloniform, secondary ascending *with irregular, curved branches turned towards one side, often flagelliform*. Leaves imbricated, ovate or obovate, *strongly papillose at back;* nerve *single, short*. Cells linear-rhomboid, shorter at apex. Capsule *erect, symmetrical, sub-cylindric;* peristome *small*, outer teeth short; inner peristome of 16 short irregular processes, without basal membrane or cilia.

DERIV.—*πτερι-*(pteri) wing, side, *γυν-*(gyn) female, and *ἀνδρο-*(andro) male; "having male and female flowers lateral."

1. Pterigynandrum filiforme Hedw. (*Hypnum filiforme* Timm) (Tab. L. L.).

In larger or smaller patches, sometimes almost entirely prostrate, at others more erect and 1-2 inches high; bright green or brownish; branches *numerous, curved, usually pointing the same way, very slender, often flagelliform*, or short and obtuse. Leaves of secondary stems and branches sub-similar, very small,

obovate or ovate-oblong, shortly pointed, not excavate at base, closely imbricated or secund, when dry secund or closely appressed and rendering the branches terete ; concave, shortly acuminate or simply acute or rather obtuse ; margin reflexed below, minutely denticulate at summit ; nerve usually faint, reaching slightly above the middle or shorter and forked ; cells *sharply and strongly papillose at back*, the greater part *shortly linear-vermicular*, at the tip wider and shorter, at mid-base longer and more pellucid, at angles *short*, irregularly quadrate and rectangular, *in a few short rows*. Seta $\frac{1}{2}$–$\frac{3}{4}$ inch long, slender ; capsule small, narrow ; lid rostrate, oblique. Dioicous.

Var. *β. heteropterum* B. & S. (*Pterig. heteropterum* Brid. in part ; var. *decipiens* (W. & M.) Limpr., Braithw. Br. M. Fl.) *More robust ;* branches *thicker*, shorter, *obtuse*, curved. Leaves *secund*, rounded and apiculate at apex.

HAB. Rocks and trunks of trees on mountains ; rare ; Perthshire ; Sutherland ; Cumberland ; Wales. The var. *β* in more shady situations. Fruit rare, summer.

Very variable in size and in the length and thickness of the branches. It has some similarity to several other species, especially, in its larger secund-leaved forms, to the more robust forms of *Heterocladium heteropterum ;* that plant has, however, more tapering leaves, more strongly denticulate and usually more distant, with shorter, less papillose cells, and the nerve always short and double. *Pseudoleskea* differs in the shorter sub-rounded areolation, as well as in the curved fruit. The present plant will generally be recognised by its numerous slender curved branches, resembling a very slender state of *Pterogonium gracile*, but with narrower leaves. On the continent it is common and fruits freely.

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99. HETEROCLADIUM B. & S.

Primary stem creeping, more or less stoloniform, irregularly divided, the secondary stems with *irregular*, *often flagelliform branches*. Leaves *of two forms ;* stem-leaves *cordate-acuminate*, branch-leaves *smaller, narrower, ovate*, less acuminate ; nerve *short, double ;* paraphyllia few. Capsule *inclined or horizontal*, curved ; peristome perfect, with cilia. Dioicous.

Differing from Thuidium in the non-pinnate branching, and the few paraphyllia, from Pseudoleskea in the double nerve, and the dimorphous leaves ; from the other genera of this Order in the curved capsule and other points.

DERIV.—*ἕτερο-*(hĕtero) different, and *κλαδιον* (cladion) a branch ; from the dimorphous leaves.

1 { Stem-leaves patent or secund ; lid rostrate.....2
  { Stem-leaves squarrose-recurved ; lid conic.....*2. dimorphum*

2 { Leaves short-pointed, not falcate, cells near margin subquadrate ..... 1. *heteropterum*
{ Leaves long-pointed, falcate, cells all elongate..... 1.* *Macounii*

1. Heterocladium heteropterum B. & S. (*Pterogonium heteropterum* Bruch) (Tab. L. M.).

In large, intricate, flat patches, *deep or bright* green. Stems creeping, the secondary ones prostrate or ascending, irregularly or sub-pinnately branched, *very slender*, often filiform; branches *straight*, rarely curved; stem-leaves *widely ovate-acuminate*, with a more or less tapering, acute point, *spreading or slightly sub-secund*, excavate at base, not concave; nerve short and double, or longer and single, often forked above; margin plane, *finely denticulate in the greater part;* median cells elliptical, 2–4 times as long as broad, towards apex and margins *shorter*, subquadrate-rounded; all rather incrassate, *distinctly papillose* on both sides. Branch-leaves smaller, less tapering, ovate, acute, *often secund*, with shorter cells. Seta purple, curved above, so that the capsule is often *horizontal* or sub-pendulous; capsule deep reddish brown, oblong, slightly curved, or gibbous, short-necked; lid-conical, *rostrate*.

Var. β. *fallax* Milde. *Extremely slender*, stems and branches all *delicately filiform;* leaves similar on stems and branches, *minute*, *narrowly elliptic-lanceolate*, not secund; cells *all short*.

HAB. Wet rocks by waterfalls, etc. The var. β rare. Fruit very rare, late summer and autumn.

An extremely variable species. Dr. Best in his Revision of the N. American species of Heterocladium (Bull. of the Torrey Bot. Club, 1901, p. 123) divides the corresponding American plants into two species, *H. Macounii* Best and *H. heteropteroides* Best, the former of a paler often yellowish green, with curved branches, leaves more or less secund, gradually acute to longly acuminate, with rather narrower elongated cells; the latter of a darker green, the leaves not secund, often complanate, the branch-leaves much less tapering, often obtuse, the cells shorter. Our plants fall very much into the same two series, the first group being considered by Dr. Best as not specifically distinct from his *H. Macounii*, the second as parallel to but not quite identical with his second species, and no doubt representing Bruch's original plant, *H. heteropterum*. After very close examination of the various forms, I cannot persuade myself that we have two specific types, as some of the above characters are interchangeable (plants of the second group, for instance, sometimes have the branches curved and the leaves strongly secund); and, moreover, intermediate forms exist. At the same time, between the extreme forms one is compelled to recognise that a very wide divergence exists, and I have given *Macounii* the rank of a sub-species.

The var. β is one of the most slender of our mosses, resembling *Amblystegium Sprucei*, and hardly to be known from some slender species of that genus except by the papillose cells, which are much shorter in the *middle of the leaf* in the variety than in the typical plant. I have it from numerous localities scattered over all parts of our islands, and have also gathered it on the continent, and in the majority of cases there appears little or nothing to indicate its relationship to *H. heteropterum* type. But on the other hand,

intermediate forms occur; plants otherwise typical not unfrequently show a tendency to produce minute-leaved flagelliform branches, similar in character to this variety; while on the other hand, plants which in the main agree with the variety may show here and there the leaves of the typical size and form. The var. *flaccidum* B. & S. is one of these intermediate forms; the present variety is cited by Braithwaite and Limpricht under that name, and Milde's name given as a synonym, but it seems evident from the description (I have not seen original specimens, of which none exist in Schimper's herbarium) of the var. *flaccidum* that Schimper could not have had the filiform minute-leaved plant in view which Milde describes as var. *fallax*, and as Schimper drops the var. *flaccidum* in the Synopsis, it must be assumed that he thought it of insufficient value to keep up, which I venture to think could not have been the case had it been the very marked, almost conferva-like plant that Milde describes, with which, therefore, I conclude he was not acquainted. The variety usually grows on rocks and stones in shady but not very moist spots. In some parts of South Wales it is by far the most frequent form, almost, indeed, to the exclusion of the typical plant.

Some forms of this species bear a resemblance to *Pterigynandrum filiforme* var. *heteropterum*, but have the leaves much more distant than is usual in that plant. In these cases it approaches nearer *H. dimorphum*, but the acumen of the stem-leaves is never squarrose-recurved as in that. The nerve varies much in length and stoutness; a form with very stout nerve reaching to mid-leaf is described by Hagen as *H. Wulfsbergii*, and is considered by Thériot also a good species; I have gathered this plant in one or two localities in N. Wales, but it appears to me to intergrade with the type.

* **Heterocladium Macounii** Best (Tab. L. N.).

Generally *pale or yellowish green. More robust* than *H. heteropterum*, with *larger* leaves, *strongly falcate-secund, gradually tapering* to a not very acute point. Cells *longer*, 3–5 times as long as broad, *less shortened* above.

HAB. Mountain rocks, rare. Scotland; Ireland. Fruit not found in Britain.

The extreme form is a very marked plant; I have a plant from Sligo (*Hunter*) which I cannot separate from the American *H. Macounii*; and I have forms from the Scotch mountains which must also be placed here. But I have numerous plants entirely intermediate between *heteropterum* and *Macounii*, and I must confess that the distinguishing characters appear to me entirely quantitative.

2. **Heterocladium dimorphum** B. & S. (*Hypnum dimorphum* Brid.; *Heterocladium squarrosulum* Lindb., Braithw. Br. M. Fl., and Handb. Ed. I.) (Tab. L. O.).

Closely resembling *H. heteropterum*; stem-leaves distant, *widely cordate-ovate, rapidly contracted to a long, flexuose, almost filiform acumen, which is squarrose-recurved*, irregularly denticulate; all median cells *and those of the acumen linear*, 6–10 times as long as wide, smooth; towards margin (in the widest part) in several rows short, sub-quadrate, slightly papillose; branch leaves much shorter and smaller, rounded and sub-obtuse or shortly

pointed, papillose, with short cells. Fruit resembling that of *H. heteropterum*, but shorter, and with a shorter, *not rostrate beak*.

HAB. Mountain rocks in shady places; very rare; Highlands of Scotland. Barren in Britain.

Very closely resembles *H. heteropterum* with the branching somewhat more pinnate and the branch-leaves are almost identical: but the stem-leaves are quite different. In *H. Mackayi* they are longly acuminate and somewhat recurved; but never with the abruptly squarrose filiform-acuminate points, nor with the elongated smooth areolation of the present species.

100. PSEUDOLESKEA B. & S.

(Leskea *nonnull. auct.*)

Alpine or sub-alpine plants with the habit of Leskea, but with longer, less rounded areolation. Paraphyllia usually *numerous; single;* capsule *curved* and *inclined*, more rarely erect or sub-erect and symmetrical; peristome well developed, inner frequently with cilia. Dioicous.

DERIV.—*ψευδο-* (pseudo) false, and Leskea; from its resemblance to Leskea.

1 { Cells elongate, the upper 4-8 times as long as wide.....*4. striata*
  { Cells short, not more than 3 times as long as wide.....2

2 { Ls. entire, very small, nerve ½ or ⅔ length of leaf.....*3. catenulata*
  { Ls. usually denticulate, larger, nerved to near apex.....3

3 { Ls. more or less secund, upper cells irregularly rhomboid, papillae from the cell ends.....*1. atrovirens*
  { Ls. spreading all round, upper cells scarcely longer than wide, papillae on face of cells.....*2. patens*

1. Pseudoleskea atrovirens B. & S., *plur. auct.* (*Hypnum atrovirens, plur. auct., non* Dicks.: *Hypnum filamentosum* Dicks.; *Lesquereuxia filamentosa* Lindb., Braithw. Br. M. Fl.) (Tab. L. P.).

Primary stems creeping, irregularly divided: secondary with irregular, hardly pinnate branches, which are *usually hooked or curved at the apex;* forming large, somewhat intricate masses of a green or brownish colour, not glossy, often turning blackish with the tips of the branches yellow; rather rigid when dry. Leaves erecto-patent, crowded, usually *falcato-secund, especially at the extremity of the branches*, secund or appressed and somewhat regularly and spirally imbricated when dry; *ovate-lanceolate, gradually* tapering to a *rather long, usually oblique* acumen, margin

recurved below, *denticulate* above; nerve *strong*, reaching to near the summit; upper cells irregular, *oval-rhomboid*, mostly *1½–2 times as long as broad*, longer near the nerve and in the point, median basal cells *shortly rectangular*, at angles quadrate; areolation almost smooth or more frequently *variously papillose from the projecting end walls of the cells*. Paraphyllia numerous, multiform. Seta short; capsule oblique, curved or gibbous, oblong; lid *conical*; peristome yellow; cilia none or rudimentary.

HAB. Alpine rocks and at the foot of trees on mountains; rare; Highlands of Scotland. Fr. spring or early summer.

As with several of the allied species, this plant is somewhat variable in the degree of robustness, the branches being sometimes very slender and filiform (var. *filamentosa* Boul.), at others robust and obtuse. The old leaves are usually dark brown or blackish, and the common form of the plant may be recognised by this dark brown tinge with the tips of the branches yellow. It somewhat resembles *Leskea nervosa*, but has less acute leaves, and a shorter nerve; and is generally more robust. *P. striata* is sometimes indistinguishable in the form and direction of the leaves, but is of a more glossy, golden brown colour, with symmetrical capsule and much longer areolation. For the differences between this species and *P. patens* see below.

2. **Pseudoleskea patens** Limpr. (*Leskea patens* Lindb.; *Hypnum atrovirens* Dicks.; *Lesquereuxia atrovirens* Braithw., Br. M. Fl.) (Tab. L. Q.).

Resembling *P. atrovirens*. Usually deep green or reddish brown, rarely if ever turning blackish; less rigid when dry, stems and branches *not* (rarely very slightly) *hooked at the tips*, leaves imbricated and *widely spreading on all sides*, rarely very slightly secund, when dry appressed and somewhat catenulate, from a widely oval base *quickly tapering to a shorter*, acute, *scarcely oblique* point. Cells *more regular and less elongate, almost as wide as long, rounded-hexagonal*, each with *a large papilla on the face of the cell* on both back and front of leaf. Fruit scarcely differing.

HAB. Alpine rocks, very rare. Ben Lawers range; Braemar. Fr. spring or early summer.

The differences between this and the last, at least the important ones, while of considerable value are chiefly microscopical, whence it happens that it is only of comparatively recent years that they have been distinguished (cf. Journ. of Bot., 1900, p. 334). This has led to much confusion in the synonymy, which unfortunately is intensified by the want of uniformity prevailing in our systems of nomenclature. In accordance with the system prevailing on the continent and adopted in this work, I have retained the name *P. atrovirens* for the plant usually known under that name, it being the combination under which the plant was first referred to the present genus. Under the system which claims priority for the specific name alone, this name *atrovirens* must be transferred from the common plant to which it has been almost universally attributed for the last century, to the rarer and less known plant which forms Dickson's type, although there is no reasonable doubt that Dickson made no distinction in his own mind between the two.

From its alpine habitat and comparatively shortly pointed spreading leaves *P. patens* is not likely to be confused with any plant but *P. atrovirens*, from which it is easily distinguished when once understood by the characters italicised in the description. It is a much more robust, looser growing plant than *P. catenulata*, and usually of a different colour, with the leaves when moist quite different.

3. Pseudoleskea catenulata B. & S. (*Hypnum catenulatum* Brid.; *Leskea catenulata* Mitt., Braithw. Br. M. Fl.) (Tab. LI. A.).

Very slender and delicate, with numerous, short, *filiform*, *julaceous*, *obtuse branches*, in low large patches of a dark or olive green or brownish yellow, not glossy. Leaves *minute*, *crowded*, erecto-patent when moist, closely imbricated when dry; ovate-acuminate, those of the branches ovate-lanceolate, acute or obtuse, *entire;* nerve *faint*, vanishing below the middle; cells *almost uniformly oval-oblong*, *short*, towards margin and apex shorter, rounded-quadrate, faintly papillose or almost smooth. Paraphyllia few, mostly narrow or filiform. Capsule narrowly oblong, inclined, curved; lid *rostrate;* cilia one or two, well developed.

Hab. Calcareous rocks on mountains, rare; North of England; Scotch Highlands. Fruit extremely rare, summer; not found in Britain.

A pretty little species, fairly easily distinguished by the julacous branches and small entire leaves with their single nerve and short cells. A remarkable forms occurs however in the Scotch Highlands of a bright yellowish green colour, with the leaves much more narrowly tapering to a slender point, which is sometimes slightly falcato-secund, with a stouter, longer nerve, and more pellucid cells with thinner walls (see Journ. of Bot. 1900, p. 417). It appears to be connected with *P. catenulata* by intermediate forms, otherwise it would scarcely be recognised as belonging to this species. A similar plant is found in the United States, and as this will probably be dealt with shortly by American bryologists, I have thought it better to do no more than refer to it here. It comes remarkably near the var. *filamentosa* of *P. atrovirens* in leaf characters, but is of softer texture and of a much brighter yellowish green colour.

4. Pseudoleskea striata Dixon (*Pterogonium striatum* Schwaeg.; *Lescuraea striata* B. & S., plur. auct., Handb. Ed. I.; *Lesquereuxia*, Braithw. Br. M. Fl.) (Tab. LI. B.).

Secondary stems very slender, creeping, rather rigid, pinnately branched above, olive or light green, slightly glossy, forming low intricate patches. Leaves erecto-patent, closely imbricated when dry, *very small*, about $\frac{1}{2}$-line in length, *narrowly lanceolate*, tapering, slightly plicate, entire or feebly denticulate, *margin reflexed* for the greater part of its length; nerve *strong*, *thick*, reaching the base of the acumen; upper cells *narrowly*

linear-rhomboid, 4–8 times as long as wide, median basal cells also *elongate, narrow,* shorter towards margin, at basal angles *quadrate,* all *smooth,* not papillose. Paraphyllia numerous, small, narrow, oval or lanceolate. Seta short, capsule *erect, symmetrical,* elliptic-oblong. Peristome teeth narrow, linear, confluent at base ; inner with a very short basal membrane.

Var. *β. saxicola* B. & S. (*Lesquereuxia saxicola* Milde, Braithw. Br. M. Fl.). *More robust, bright glossy golden green,* branches curved or hooked at tips, leaves larger, *wider,* often *sub-secund, ovate-lanceolate,* more concave, *more frequently denticulate above.*

HAB. Stems of shrubs and trees in mountainous countries. The var. *β* alone found in Britain, on alpine rocks ; Ben Lawers range. Fr. spring.

The var. *saxicola* alone has been found, on the Ben Lawers range only. It is by some authors considered a separate species, but scarcely on good grounds ; leaves varying in width and in other characters may be found on the same plant. The slender, almost filiform stems, and minute leaves with long nerve have some resemblance to *P. atrovirens,* but the colour is much paler, the cells smooth and much more elongate, especially at base, and the capsule erect.

I have no doubt that Dr. Best is right in making Lescuraea a sub-genus of Pseudoleskea (Revision of N. Amer. species of Pseudoleskea, Bull. of Torrey Bot. Club, 1900, p. 221). Some of the American species of Pseudoleskea, including *P. rigescens* Lindb. (*P. stenophylla* Ren. & Card.), which is also European, have the capsules erect and symmetric, with occasional intermediate forms, and the leaves may be either smooth or papillose ; while the difference in areolation alone is not sufficient to give generic distinction. The longer, narrower, smooth cells will however distinguish the present from all the preceding species, while it is scarcely likely to be confused with any of the Hypnaceae, the long stout nerve and comparatively short cells clearly characterising it. *Brachythecium populeum* might perhaps be so confused, but has a thinner nerve, larger leaves and the marginal areolation at base quite distinct.

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101. THUIDIUM B. & S.

Primary stem prostrate, irregularly divided ; secondary stems *regularly pinnate, bipinnate or tripinnate.* Paraphyllia *numerous,* multiform. Leaves *dimorphous,* the stem-leaves differing much from the branch-leaves, *single-nerved,* strongly papillose. Capsule rather large, thick-walled, *arcuate.* Peristome large, perfect.

Readily distinguished from all the preceding genera by the regularly pinnate branching, copious, branched paraphyllia and curved, hypnoid capsule.

Lindberg first pointed out the radical distinction in the apical cells, between the branch-leaves of *T. tamariscinum* and those of *T. recognitum* and *T. delicatulum,* by which these groups of species may be separated at a glance under the microscope ; the

difficulty of separating them when barren, and indeed even when fruiting, previously to that time, had caused great confusion between the species, especially in N. America. In *T. tamariscinum* the apical cell in the branch-leaves ends in a single acute point; in the other species named it is truncated, with 2–3 points or papillae at apex.

I have followed most recent authorities in removing *T. decipiens* to the genus *Hypnum* near to *H. commutatum*.

DERIV.—Diminutive of Latin *Thuja*, the botanical name for a small feathery branched coniferous tree. The name being derived thus, and not directly from the Greek θυα (thya), there seems no reason for correcting the spelling, as Lindberg does, to Thyidium.

1 { Stem bi- or tripinnate 2
  { Stem simply pinnate 5

2 { Apical cell of branch-ls. acute, not divided ..... *3. tamariscinum*
  { Apical cell obtuse, bifid or ending in a crown of papillae 3

3 { Stem leaves erect, not recurved at points, perichaetial bracts ciliate *4. delicatulum*
  { Stem leaves recurved at points; bracts not ciliate 4

4 { Apex of stem-ls. finely acuminate but scarcely filiform ... 5. *recognitum*
  { Apex of stem ls. terminating in a filiform point ..... 5*. *Pholiberti*

5 { Stem rigid; ls. papillose on keel; cells shortly oval 6
  { Stem flexible; ls. smooth on keel; cells elongated ..... *2. Blandowii*

6 { Branches slender, terete when dry; cells of branch-ls. about 1½ times as long as wide ..... *1. abietinum*
  { Branches robust, not terete when dry; cells 2-3 times as long as wide *1.* *hystricosum*

1. Thuidium abietinum B. & S. (*Hypnum abietinum* L.) (Tab. LI. C.).

In loose tufts, often scattered among grass and other plants, green or *dark brown with yellow or green tips*; secondary stems 2–4 inches long, prostrate or ascending, sometimes forked, *rigid*, *simply and regularly pinnate* (very rarely slightly bipinnate), the branches close, sub-equal, not complanate, but in four rows, two on each side of the stem, so as to lie in two planes, slender, short, *terete*, *mostly acute and often flagelliform*; stem-leaves crowded, spreading when moist or slightly secund, when dry closely appressed and imbricated, *widely oval*, with a short point or a longer, tapering acumen, acute, strongly plicate, margin slightly recurved, denticulate above; nerve strong, reaching ¾ the length of the leaf or higher; cells *minute*, *oval*, incrassate, at mid-base very slightly elongated, towards basal margins shorter, *sub-quadrate-rounded*, all highly papillose at back. Paraphyllia numerous, *short*, multifid, often united with the leaf at base. Branch-leaves much smaller, crowded, *ovate*, *shortly acuminate*, concave, when dry *closely imbricated*, *so that the branches are*

terete, areolation minute, *oval, or irregularly rounded*, about 1½ times as long as wide, highly papillose, especially at back; the apical usually bifid, rarely simply acute; nerve hispidly papillose at back. Perichaetial bracts long, gradually attenuated, plicate, without cilia. Capsule sub-erect, curved, cylindrical, slender; lid conical, acuminate. *Dioicous*.

HAB. Among grass and herbage, principally on dry calcareous soil; frequent. Fruit extremely rare, not found in Britain.

T. abietinum varies in slenderness and in the form of the stem-leaves, but not to any great extent in other directions. It is readily distinguished from *T. Blandowii* and *Hypnum decipiens* by the habitat, the closely imbricated branch-leaves, the areolation, the more rigid texture of the stem and leaves, etc., and from the former notably by the dioicous inflorescence; from all the other species by the simply pinnate stems. For the differences between it and the sub-species *hystricosum* see under that plant.

This and the next two plants belong to Mitten's sub-genus Tetracladium, distinguished by having the branches not complanate, but in four rows, two on each side of the stem, the upper on one side and the lower on the other being in the same plane. This is noticeable in fresh plants, especially in the more erect-growing forms, and in specimens which have not been subjected to pressure; in herbarium specimens which have been pressed flat it is of course indistinguishable, but may be recovered more or less by immersion in water.

*** Thuidium hystricosum** Mitt. (Tab. LI. D.).

More robust than *T. abietinum*, with denser *stouter* branches, which are usually obtuse, rarely attenuated. Stem-leaves more deeply plicate, much larger, wider, *tapering to a longer*, more spreading, *finer acumen*, those on the under side of the stem secund and decurved. Branch-leaves *much longer, gradually tapering to a very fine acute point*, slightly secund, *not appressed, but loosely incumbent when dry, so that the branches are not terete*. Upper cells of branch-leaves slightly narrower and more elongated, in the apex especially *2–3 times as long as wide*. Fruit unknown.

HAB. Chalk hills in the south of England; Yorkshire; Perthshire; rare.

Although in its extreme form this has a very distinct appearance, and in the form and size of the leaves is very distinct from typical *T. abietinum*, it cannot, I think, in any case take a higher rank than that of a sub-species. There is, to begin with, a considerable discrepancy in the descriptions by different authors which suggests that the distinctive characters are either inconstant or not too well marked. Moreover, a study of a large series of forms of *T. abietinum* shows a considerable tendency to vary in the direction of *T. hystricosum*, and intermediate forms occur on the continent (cf. *Rev. Bry.*, 1902, p. 61), nor are they altogether wanting here. Cardot, after studying the European forms, has expressed a similar opinion.

The student will however in most cases have little difficulty in recognising our plant by comparing the figures and the descriptions of the two. In my experience the most easily observed character in the field is the robust build

of the branches when dry, caused by the loosely incumbent, longly tapering leaves, which in *T. abietinum* are shortly pointed and closely appressed so that the branches are almost terete.

2. Thuidium Blandovii B. & S. (*Hypnum Blandovii* W. & M.) (Tab. LI. E.).

Somewhat resembling the last species, but of a *brighter, paler colour*, and *softer texture;* bright yellowish green above, pale below; stems *not rigid*, leaves soft, thin and somewhat membranaceous in texture. Stems and leaf-bases thickly coated with numerous *long and branched*, filiform, pellucid, jointed paraphyllia; stem-leaves wide, *cordate acuminate*, often much narrowed at the base, thin and pellucid, irregularly plicate, *densely crowded, so as to render the stems tumid;* margin slightly recurved, or plane, towards base spinulose-denticulate; nerve *thin*, reaching above half-way; cells *narrowly vermicular-elliptical, or linear-rhomboid, 4–6 times as long as broad*, longer and more vermicular at apex, longer and *narrowly rectangular at base;* at back with strong but not very dense papillae, *usually arising from the end-walls*, not from the face of the cells. Branches slender, attenuated, *simple*, close and regular, longer than in the last species, the leaves less crowded, *when dry divergent from the branch at base, then incurved, so as to render the branches somewhat catenulate, not terete*, branches as well as stems clothed with long paraphyllia; leaves small, narrower, acuminate, almost entire; areolation resembling that of the stem-leaves. Setae long, slender, red, 1½–2 inches, numerous, from the upper part of the stem; capsule arcuate, oblong-cylindric, wider than in the last; lid conical, acuminate. *Autoicous.*

HAB. Bogs and marshes. Very rare. England. Fr. summer.

This fine species, which is often seen in abundant fruit, has only been found in two or three bogs in England; it is frequent in North America and some of the more northern European countries. Its habitat alone is sufficient to separate it from all the other species except the next, besides which the simply pinnate stems distinguish it from all but *T. abietinum* and *Hypnum decipiens*. The latter is known by its falcate leaves, wide angular cells, etc., the former by the characters pointed out in the description of that species.

3. Thuidium tamariscinum B. & S. (*Hypnum tamariscinum* Hedw.; *Th. tamariscifolium* Lindb., Braithw. Br. M. Fl.) (Tab. LI. F.).

Stems elongated, 3–9 inches long or more, arched, *often interrupted*, the apex being produced without branches for some distance, and often rooting, then again branching; this may be repeated several times. Plants in large, intricate mats, *bright vivid green*. Branches complanate, *tripinnate*, the lower or

median ones longest, so that the outline of the frondiform stem is deltoid or lanceolate ; secondary and tertiary branches short, very slender, attenuated. Stems and branches clothed with numerous short, multifid paraphyllia. Stem-leaves widely cordate, from a broad base, *rapidly contracted to a narrow but not very finely tapering acumen* of varying length, plicate ; erecto-patent or very slightly recurved, when dry *appressed*, not crowded ; margins revolute to the base of the acumen, denticulate above ; nerve very strong, reaching nearly to apex ; cells *short, wide*, incrassate, *rounded-quadrate or irregular*, in acumen elongated, elliptical ; towards base longer, sub-rectangular ; at basal angles rectangular, slightly larger. Papillae acute. *dense*. Leaves of the primary branches somewhat intermediate between those of the stem and of the secondary and tertiary branches ; of these latter very small, narrow, ovate-lanceolate, shortly pointed, concave ; cells oval-rounded, densely papillose, *the apical cell simply acute*. Perichaetial bracts long, gradually or rapidly contracted to a long, flexuose, thong-shaped acumen, much longer than the limb ; the margins, especially of the inner ones, *densely fringed with long, filiform, articulate cilia ;* nerve strong, reaching to base of acumen. Seta stout, 1–1½ inches long, purplish red ; capsule large, thick-walled, arcuate, dark reddish brown ; lid longly and obliquely rostrate ; peristome large, reddish. Dioicous.

HAB. Shady woods, common. Fr. not common, autumn and winter.

This very fine and beautiful species cannot be mistaken for any other except the two following ; from these it is readily separated by the apical cell of the branch-leaves, which is here smooth and simply pointed, while in them it is truncate and bi-trifid with terminal papillae. *T. recognitum* also differs in the branching being shorter and bipinnate, rarely tripinnate, and in the perichaetial leaves not ciliate ; and both that and *T. Philiberti* are distinguished by the finer, recurved points of the stem-leaves ; while *T. delicatulum* may sometimes, but not always, be known by its smaller size.

The broad, complanate, regularly branched stems of this moss have much the appearance of miniature fronds of a fern. The mode of formation of new stems and prolongations of the older ones is very similar to that of *Hylocomium splendens*.

4. Thuidium delicatulum Mitt. (*Hypnum delicatulum* Hedw., *non* B. & S.) (Tab. LI. G.).

Very closely resembling *slender* forms of the last species, and occasionally fully as robust ; bright green above, reddish brown below. *Branching tripinnate*, the branches and branchlets usually shorter and more numerous and crowded than in that species. *Apical cell of the branch-leaves truncate and crowned with 2, more rarely 3 papillae, so as to appear* bifid. Perichaetial bracts *fringed*, especially the inner ones, *with less numerous, shorter cilia*. Capsule usually (but not always) rather smaller and less curved.

Hab. Among rocks and sand by streams, and in woods in sub-alpine districts. Frequent and often abundant in Wales, the Lake District, and Scotland. Ireland. Fr. winter.

Typically a more delicate, more compact plant with denser, more slender branches than the last, but occasionally fully as robust, and then quite indistinguishable without the microscope, when the apical cell of the branch leaves at once distinguishes it. The cilia are sometimes very few, and in this and the succeeding plants somewhat unreliable as test characters, though as a rule they occur in the present species.

There was great confusion between this species and the last until Lindberg detected the wide difference in the apical cells of the branch-leaves. It is curious that *T. tamariscinum*, by far the commoner species of the two in Europe, is quite absent in N. America, and replaced there by the present plant. It was unknown in Britain until quite recently when Mr. Holt discovered it at Tyn-y-groes, with fruit; since that time it has been detected in numerous localities, chiefly in the western, mountainous districts of our islands, where it is often abundant. I have occasionally gathered it in mountain bogs.

Breidler is said by Husnot (*Muscol. Gall. p.* 309) to have observed the perichaetial bracts with and without cilia on one and the same specimen. I have found them very slightly developed in some specimens, and in *young* perichaetia sometimes hardly visible.

Both this and the preceding species differ from the two following plants in the stem leaves, which are shortly pointed, appressed when dry and only slightly spreading, not recurved, when moist; in *T. recognitum*, and still more in *T. Philiberti*, the narrow acumen is strongly recurved when moist, and often when dry also. For other differences compare the descriptions of those plants.

5. Thuidium recognitum Lindb. (*Hypnum recognitum* Hedw.; *T. delicatulum* B. & S., *non* Mitt. *nec* Lindb.) (Tab. LI. H.).

Resembles slender forms of *T. tamariscinum* but is usually of a *yellowish* hue, not bright green, the branching *bipinnate*, in luxuriant specimens occasionally slightly tripinnate; fronds more linear in outline, rarely distinctly deltoid or lanceolate, owing to the primary branches being sub-equal; less frequently interrupted than in that species. Stem-leaves with *much longer points*, the nerve usually reaching higher in the acumen, which is *strongly recurved* when moist and often when dry also, at apex *very finely acute*. Branch-leaves and *apical cells as in T. delicatulum*. Perichaetial bracts *not ciliate*, denticulate only, sub-erect and somewhat rigid, tapering to a narrow thong-shaped acumen *about as long as the base*. Capsule arcuate, large, rather slender. Annulus broad, separating.

Hab. Calcareous woods mountain rocks, etc., principally on calcareous soil. Rare, perhaps overlooked as a small form of *T. tamariscinum*. Fr. very rare, winter.

Distinguished from *T. tamariscinum* by the apical cells of the branch-leaves, and from the last by the branching being bipinnate only, by the non-ciliate perichaetial bracts, and by the smaller stem leaves, with less strongly recurved margins and broad nerve passing into the acumen and almost

percurrent. The uppermost leaves are usually falcato-secund with the points curved downwards. I can find no difference between the upper cells of the branch-leaves in this and *T. delicatulum*, such as Husnot describes.

*** Thuidium Philiberti** Limpr. (*T. intermedium* Philib. *non* Mitten) (Tab. LI. I.).

Resembles *T. recognitum*, but usually more robust, often reddish brown, bipinnate, not unfrequently tripinnate; stem-leaves larger, with margins more recurved, prolonged into a *filiform acumen, composed of a single row of 3–8 linear hyaline cells;* nerve narrowing above, lost at base of or in mid-acumen. Perichaetial bracts looser, *more spreading and flexuose*, tapering into a very long thong-shaped acumen, *about three times as long as the base*. Annulus *narrow*, indistinct, not readily separating.

HAB. Chalk downs and wet calcareous rocks on mountains, not uncommon. On several of the Perthshire mountains. Fr. not found with us, winter.

Chiefly distinguished from *T. recognitum*, and indeed all our species, by the long, filiform point of the stem-leaves, showing an approach to that of some exotic species, such as *T. cymbifolium* Dozy & Molk. The perichaetial bracts also show a certain difference, and there are other characters, but they are not of very great value, and it must, I think, be placed as a sub-species of the former plant.

For more detailed remarks on the differences between our species of this group I may refer to a paper in Journ. of Bot., 1913, p. 189.

T. Philiberti is a rather distinctly calciphilous plant, not infrequent on chalk slopes, but also found on mountain rocks. *T. recognitum* is more distinctly a woodland moss, though less so than *T. delicatulum*.

ORDER XXV. HYPNACEAE.

Stems variously branched; leaves variable in form and in direction. Cells narrow and elongated, from shortly rhomboid to narrowly linear-vermicular, at least twice as long as wide and usually much longer; smooth or very rarely sparsely and minutely papillose; nerve single, double, or none. Capsule on an elongated seta, usually arcuate, less commonly erect and symmetrical; peristome well developed; inner almost always with a distinct and more or less elevated basal membrane, frequently with cilia between the processes.

Under this Order I have included all the British genera of pleurocarpous mosses with elongated, smooth areolation and well developed bryoid peristome; those species of course excepted which with the above characters are separated, on important grounds, under Neckeraceae. The cells, though occasionally short and

wide, always in such cases show a rhomboid or hexagonal outline, and are never regularly oval, rounded, nor quadrate, at least in the middle of the leaf.

The texture of the leaves is usually thin and membranaceous, often somewhat scariose and glossy; when dry they rarely become crisped, though sometimes shrinking and becoming flaccid; as a rule they are little altered when dry, and on moistening regain rapidly their normal condition.

Several of the genera here included with erect, symmetrical capsules are frequently separated under the title of Orthotheciaceae; but the distinction cannot be held of real importance, since it leads to the separation of genera obviously closely allied.

The student will have little difficulty in recognising a moss as a member of this Order if attention be paid to the areolation. Pterogonium, Antitrichia and Leucodon, indeed, have somewhat elongate upper cells, but the marginal cells in the lower part of the leaf, not the angular ones only, are short and rounded; perhaps *Pseudoleskea striata* is the only species previously described about which any doubt might arise.

In the descriptions of the leaves, when not otherwise stated, those of the secondary stems or their divisions are referred to, not those of the branches; the branch-leaves being usually narrower and frequently less highly developed than the stem-leaves.

In the arrangement and the divisions into genera, as well as in the nomenclature, I have for the most part followed the system of the authors of the Bryologia Europaea, and of Schimper in the Synopsis, Ed. II. This arrangement is open to much criticism, both as to nomenclature and to the value of the genera; it is, for instance, to say the least doubtful whether groups like Camptothecium and Brachythecium have any claim to a separate generic rank which puts them on the same level as the genera of Acrocarpous mosses, separated only as they are by characters almost indefinable and none too constant. Lindberg has given an original and very different arrangement in the Musci Scandinavici; but, besides that some of his grouping appears very difficult to justify, I have thought it better not to run the risk of causing confusion by the introduction of an arrangement and nomenclature so widely differing from that of most of the works the student is likely to consult, and have therefore kept more or less closely to the old lines. The chief variation will be found in the uniting of Pleuropus with Camptothecium, and Isothecium *Brid.* and Rhynchostegium *B. & S.* with Eurhynchium, the differences by which the latter genera are sometimes separated being very slight in degree and not easy either of definition or of detection.

Dr. Grout has laid down some very sound principles of classification in an article on the Classification of the Pleurocarps in Rev. Bry. 1899, p. 73.

102. CLIMACIUM W. & M.

Primary stem creeping, stoloniform, secondary erect, *robust, dendroid;* branches *stout, not flagelliform*, stem-leaves scale-like; branch-leaves oblong-lanceolate, *plicate, single-nerved.* Areolation *rather long, rhomboid*, rounded at the ends. Seta *long;* capsule *sub-cylindric, erect;* peristome large; outer teeth confluent at the base, reddish; inner with a short basal membrane, processes perforated and widely gaping along the keel, cilia rudimentary or none. Dioicous.

The true position of this genus is difficult to decide. In the areolation it certainly appears to belong to the present Order rather than to Leucodontaceae. It seems however in some respects near Porotrichum, and on the whole must be considered a somewhat anomalous genus.

DERIV.—κλιμαξ (klimax) a staircase. Alluding to the appearance of the processes of the inner peristome, the two halves of which are regularly united by projections between the perforations, giving somewhat the appearance of a ladder.

1. Climacium dendroides W. & M. (*Hypnum dendroides* L.; *Climacium epigaeum* Stirt. in Ann. Scot. Nat. Hist. xix, 240) (Tab. LI. J.).

Robust, secondary stems *erect, rigid*, 2–4 inches high, *unbranched except towards the summit*, where they give rise to numerous sub-erect, rarely spreading branches, which are usually straight, either short and obtuse or longer, more slender and cuspidate, but not flagelliform; *somewhat thick and turgid with the closely imbricated leaves;* bright or yellowish green. Leaves *large*, those of the stem *very broad, amplexicaul*, rounded and cucullate and often apiculate at the apex; branch-leaves narrower, *oblong-lingulate* with the apex usually rounded and obtuse, *coarsely serrated above and more finely almost to base;* somewhat cordate at base with the margins incurved, *plicate;* nerve *narrow*, ceasing just below apex. Cells *narrowly rhomboid, 6–8 times as long as wide*, the basal looser, at the angles a few, lax, wide and hyaline, forming minute auricles. Seta an inch long or more, deep red; capsule erect, elliptic or cylindric, reddish brown; lid *straight*, acutely rostrate, remaining for some time attached to the columella and persistent. Peristome large. Calyptra descending below the capsule.

HAB. Damp marshy ground, frequent. Fr. very rare, autumn and winter.

A plant of a very distinct habit, somewhat resembling *Porotrichum alopecurum* in habit and manner of growth, but still more dendroid in appearance

owing to the shorter, straighter, more compactly tufted branches; the areolation is however quite different. The fruit when it occurs is produced in abundance, and the plant is then a very fine and beautiful one.

103. CYLINDROTHECIUM B. & S.

Primary stems hardly distinct, secondary erect or depressed, *more or less pinnately branched*. Leaves ovate or lanceolate, *nerveless or with two short nerves*. Capsule *erect, symmetrical*, oblong or cylindric; lid conical. Inner peristome *without a basal membrane*, processes nearly or quite as long as the outer teeth; *cilia none*.

DERIV.—κυλινδρος (kylindros) a cylinder, and θηκιον (thēkion) a little vessel; from the form of the capsule.

1. Cylindrothecium concinnum Schp. (*Hypnum concinnum* De Not.; *Entodon orthocarpus* Lindb., Braithw. Br. M. Fl.) (Tab. LI. K.).

In large loose tufts, yellowish or brownish green, 2-5 inches high; erect or somewhat depressed; closely resembling *Hypnum Schreberi*. Stems *pale or brown* (not red as in that plant); branches *more or less regularly pinnate, crowded*, rather short, *terete* with the closely imbricated leaves, *cuspidate*. Leaves *widely ovate-oblong*, when dry erect and closely imbricated, slightly more spreading when moist, *concave, glossy, obtuse* or minutely pointed, *entire*, margin recurved at base, involute and sub-cucullate at apex; *nerveless or with 2-3 faint traces of nerve* at the base; cells *narrowly linear-vermicular*, long, at apex shorter, wider, oval, at base somewhat laxer, at basal angles *quadrate*, thin-walled, forming rather large triangular bands. Capsule cylindric, lid conical, apiculate; peristome reddish. Dioicous.

HAB. Among grass, etc., on calcareous soil, not common. Fruit very rare, not found in Britain, late summer and autumn.

Very similar in appearance to *Hypnum Schreberi*, though quite different in the fruit. It may be known from that species by the pale or brown, not red stems, and by the basal angular cells which are less distinct, not hyaline nor orange, and not forming such distinct auricles. It is as a rule, also, a more compact plant, with the branches shorter and, while cuspidate, less attenuated, but the latter characters are not quite constant. *H. cuspidatum* is also like it, but is taller, more slender and elongated, with the basal auricles much more distinct, and is usually of a bright green or bright golden brown, and less densely pinnate, with the leaves much less imbricated when dry. It is also somewhat like a starved form of *Brachythecium purum*, but that is always of softer texture, with larger, apiculate, nerved leaves.

104. **MYURIUM** Schp.

Stems irregularly branched; branches *julaceous* with the very concave, closely imbricated leaves, *tumid*. Leaves *cochleariform, suddenly piliferous, nerveless*. Areolation *narrow, vermicular*. Flowers and fruit unknown.

The position of this genus must remain doubtful in the absence of fruit. From the areolation, however, it is certainly more at home in the Hypnaceae than under Leucodon, with which it was formerly united.

DERIV.—μυουρος (myouros) mouse-tailed. Alluding to the julaceous branches.

1. Myurium hebridarum Schp. (*Leucodon Lagurus* var. *borealis* Wils.; *Hypnum Hochstetteri* Schp., Braithw. Br. M. Fl.) (Tab. LI. L.).

In large, dense tufts, readily falling apart. Primary stem prostrate, with numerous crowded, erect divisions, simple or slightly branched, 1–2½ inches high, *thick, tumid, obtuse, golden yellow*. Leaves in many rows, rather large, *cochleariform, shining*, loosely imbricated, *oblong, suddenly contracted to a long, linear-piliform point*, excavate and somewhat auricled at base; margin involute above, finely denticulate throughout its length, most closely and distinctly at apex and at basal margin; nerve *faint or none*. Cells very narrow, *linear*, the walls incrassate and perforated by pores, at base gradually shorter and wider, hexagonal, especially at angles, but not clearly differentiated at the auricles.

HAB. Near the coast on earth and among rocks. Inner and outer Hebrides; West Inverness; Tiree.

A very beautiful and a curious plant, both in structure and distribution. Its only other known stations are in the Canaries and Azores. The leaves are somewhat like those of *Eurhynchium cirrosum*, but are nerveless, with wider points, and the whole plant is much larger and stouter. It resembles perhaps most nearly the most robust forms of *H. cupressiforme* var. *elatum*, but the leaves are straighter, more suddenly and more finely pointed, and the basal areolation quite distinct.

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105. **PYLAISIA** B. & S.

Plants of arboreal habitat, growing in intricate, *silky* tufts. Stems prostrate, rooting, not stoloniform. Leaves small, ovate-lanceolate, *longly acuminate, nerve short or none*. Basal angular cells *numerous, quadrate*. Seta smooth. Capsule *erect*, elliptic-

oblong or cylindric ; peristome well developed, cilia rudimentary, single. *Autoicous.*

A genus of several species, similar in habit and leaf-form, and also characterised by the autoicous inflorescence.

DERIV.—After De La Pylaie, an eminent bryologist.

1. Pylaisia polyantha B. & S. (*Leskea polyantha* Hedw. ; *Stereodon polyanthos* Lindb., Braithw. Br. M. Fl.) (Tab. LI. M.).

Stem prostrate, irregularly divided, in *small silky tufts*, hardly one inch high, dull yellowish green. Secondary stems *closely pinnate, the branches erect or ascending*, short. Leaves erect or secund and pointing upwards, small, *less than half a line long*, narrowly ovate, *rather rapidly contracted into a tapering acumen* of almost equal length, entire, slightly concave, not plicate ; margin plane ; *nerveless or with a faint and short single or double nerve ;* cells *linear-rhomboid*, thin-walled, 6–10 times as long as broad, at basal angles *quadrate, pellucid*, often orange, rather wide and distinct. Setae numerous, slender, about ¾–inch high ; capsule oblong, small, narrow ; lid *conical, acute, short.* Processes of inner peristome longer than the outer teeth.

HAB. Trunks of trees and stems of bushes in hedgerows, rare. Fr. autumn and winter.

Very closely resembling in habit slender forms of *Camptothecium sericeum* and also *Hypnum cupressiforme* var. *resupinatum ;* the long nerve of the former at once separates that species, and the latter is known by the longer, shortly rostrate lid, the capsule larger and slightly curved, the cilia well developed, the dioicous inflorescence, the areolation usually narrower, linear-vermicular, and the basal angular cells forming rather more defined auricles. *H. incurvatum* has rather narrower leaves and a curved capsule, and moreover grows on rocks. Our species is usually found abundantly fruiting.

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106. ORTHOTHECIUM B. & S.

Rupestral plants ; stems prostrate, irregularly branched. Leaves *glossy*, nerveless ; areolation long, linear, *without distinct basal angular cells.* Seta *smooth.* Capsule erect or very slightly inclined ; cilia rudimentary. *Dioicous.*

The species of this genus are distinguished from Pylaisia by the absence of distinct angular cells, the dioicous inflorescence and the rupestral habitat ; from Camptothecium by the absence of nerve.

DERIV.—*ὀρθο-*(ortho) upright, and *θηκιον* (thēkion) a little vessel. From the erect capsule.

{Small ; leaves sub-secund, scarcely striate.....*2. intricatum*
{Larger ; leaves imbricate, strongly plicate.....*1. rufescens*

1. Orthothecium rufescens B. & S. (*Hypnum rufescens* Dicks. ; *Stereodon rufescens* Mitt., Braithw. Br. M. Fl.) (Tab. LII. B.).

Secondary stems crowded, erect or ascending, *robust*, little branched, forming large, densely crowded tufts, 1–3 inches high, of a glossy *vinous pink or reddish green*. Leaves crowded, *erecto-patent*, hardly altered when dry, not erect nor appressed, so that the branches are obtuse, not cuspidate ; scariose, *plicate*, triangular-lanceolate, gradually narrowed from the base, tapering to a long, narrow acumen, large, 1–1½ lines long, entire, margin recurved for the greater part of its length ; *nerveless*, or very faintly nerved ; cells very narrow, linear, the walls incrassate and somewhat porose, *uniform to the base*, a very few along the line of insertion slightly looser, often reddish. Seta about one inch long, red ; capsule oblong-cylindric with a tapering neck ; lid rostellate ; peristome pale yellow.

HAB. Damp clefts of calcareous rocks on mountains, rather rare ; England ; Scotland ; Wales ; Ireland. Fruit very rare, summer.

A very beautiful species when growing in favourable conditions, forming large deep tufts of a rich vinous red, with robust stems and large leaves, bearing more resemblance, perhaps, to *Camptothecium nitens* than to any other plant ; that species is however known at once by the nerved leaves and by the paludal habitat. The present is a much more robust plant than the next species, though the larger forms of that approach very nearly to the most slender forms of this, but the leaves are always narrower and almost or quite destitute of plicae.

2. Orthothecium intricatum B. & S. (*Leskea intricata* Hartm. ; *Stereodon subrufus* Lindb., Braithw. Br. M. Fl.) (Tab. LII. A.).

Much more slender, secondary stems ascending, arcuate, with a few branches ; yellowish green or reddish, in silky, intricate tufts, 1–1½ inches high ; leaves very glossy, almost always *secund and homomallous ;* resembling those of the last in shape, but *much smaller*, ¾–1 line long, and *not plicate ;* margin plane ; nerve none or obsolete, areolation as in *O. rufescens*. Seta short, about ½-inch, capsule small, oval-oblong.

Var. *β. binervulum* Husnot (*O. binervulum* Mol.). Leaves *wider, ovate*, less longly acuminate, *sub-plicate*.

Var. *γ. abbreviatum* Dixon in Journ. of Bot., lxi, 284 (1923). Very compact and small, blackish below. Stems filiform, leaves *minute, very shortly* acuminate. Cells *short*.

HAB. Damp sub-alpine calcareous rocks, not common. Fruit summer, only found in Britain on the shores of L. Tay, Perthshire (*Hunter*). The var. *γ* on Yoredale limestone rocks, Yorkshire ; Westmorland.

This species somewhat resembles *Hypnumc upressiforme* var. *resupinatum*, but is of a more reddish colour, less branched, with the leaves more longly acuminate, and no distinct angular cells, and is moreover confined to calcareous rocks ; the same characters will separate it from *Pylaisia polyantha*, and to a great extent from *Plagiothecium pulchellum ;* the latter plant has shorter, wider leaves, with wider cells, especially at base.

Husnot mentions the var. β as being found in Scotland, but I have seen no other record, nor have I seen specimens. His figure, however, would seem to indicate that it is a marked variety (*Muscol. Gall.* p. 317, Tab. 90).

In the dense compact habit, dull olive green colour, minute leaves, very shortly pointed, with very short, sometimes rhomboidal cells, the var. *abbreviatum* is a strongly marked plant.

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107. CAMPTOTHECIUM B. & S.

Stem erect or prostrate, irregularly or sub-pinnately branched. Leaves lanceolate-acuminate, *single-nerved, deeply plicate ;* cells *narrow-linear almost to base, wider and quadrate-rectangular at angles*. Seta smooth or rough. Capsule erect and symmetrical or more or less inclined and curved, *oblong-cylindric ;* lid conical-rostellate. *Dioicous*.

A fairly well defined genus, differing from Orthothecium in the nerved leaves ; from Brachythecium in the narrow-linear, not rhomboid areolation, almost uniform to base except at the angles, and the more cylindrical capsule.

I have after some considerable hesitation united *Pleuropus sericeus* (*Homalothecium* B. & S.) with Camptothecium. The characters on which Homalothecium was propounded in the Bry. Eur., by which it is separated from Camptothecium, are almost solely the erect, symmetrical capsule, and the imperfect inner peristome. The capsule however in Homalothecium is not constant in its form and direction, being sometimes slightly curved even in our own species, and it will, I think, be generally admitted that the differences in the structure of the peristome would not alone afford sufficient basis for generic separation. The close affinity of the two genera is also testified to by the fact that *H. fallax* Philib. has been placed under each genus alternately at different times. My principal hesitation lies indeed not in uniting these two, but in finding sufficient ground for separating the whole group from Brachythecium. In addition however to a certain value in the form of the capsule, there is a distinct character in the areolation of Camptothecium which I think justifies its retention as a separate genus.

DERIV.—καμπτο-(kampto) bent, and θηκιον (thēkion) a little vessel ; from the curved capsule.

1 { Stem scarcely radiculose ; seta rough 2
  { Stem copiously tomentose ; seta smooth ..... *3. nitens*

2 { Capsule erect or almost so, cylindric ; stems creeping ..... *1. sericeum*
  { Capsule smaller, inclined, curved ; stems rarely creeping ..... *2. lutescens*

1. Camptothecium sericeum Kindb. (*Hypnum sericeum* L., Braithw. Br. M. Fl.; *Homalothecium sericeum* B. & S., plur. auct.; *Pleuropus sericeus* Dixon, Handb. Ed. I.) (Tab. LII. C.).

In wide patches, bright or yellowish green; *very glossy, pale and silky when dry*. Stems *creeping*, radiculose, with *densely crowded, erect, slender, often curved branches*, somewhat terete when dry. Stem-leaves rather large, about 1 line long, triangular-lanceolate, *gradually narrowed from the very base, at apex filiform-acuminate*, erecto-patent when dry erect and somewhat appressed; at basal angles somewhat strongly denticulate, above entire or obsoletely denticulate; *deeply 3–4 plicate;* one or other margin usually very narrowly recurved; nerve rather narrow, reaching ¾ the length of the leaf. Areolation very long and narrow, linear, slightly vermicular, *12–20 times as long as broad, uniform to base;* at extreme base shorter and slightly laxer, not much incrassate nor distinctly porose, at angles *wider, quadrate-hexagonal, irregular*, forming distinct, somewhat enlarged, decurrent toothed auricles. Branch-leaves smaller, narrower. Seta *rough*. Capsule rather large, pale brown, oblong-cylindric, *erect*, symmetrical or often a little curved; usually wider at base and somewhat tapering to the narrowed mouth; lid red, shortly rostrate. Calyptra often hairy at base. Processes of inner peristome *short*, not perforate, cilia *wanting*. Dioicous. Male plants in separate tufts, very slender.

HAB. Trunks of trees and stone walls. Common. Fr. spring.

The male plant of this moss is extremely slender, and very unlike the fertile; this is quite distinct in its habit, from its crowded, erect branches, very silky and glossy, especially when dry. The strongly plicate leaves and long nerve easily separate it from all allied plants except the two following species, and perhaps *Brachythecium glareosum;* and its creeping stems with crowded erect branches, and very silky gloss, distinguish it from the ordinary forms of these. The areolation of *B. glareosum* is much looser, especially at base; the habitat and tomentose stems of *C. nitens* at once distinguish that species, while *C. lutescens* is known by the fruit, and usually by the larger, more rigid leaves, and less terete branches when dry, The fruit is not unfrequently produced, and then usually in great quantity. The leaves are more appressed when dry than in most of the allied species, and it is their pale glossy under side that gives the dry plant its peculiar, silky character. The difference in habitat must also be remembered, when comparison is made with the above-mentioned species.

2. Camptothecium lutescens B. & S. (*Hypnum lutescens* Huds., Braithw. Br. M. Fl.) (Tab. LII. D.).

Stems tufted, in irregular patches, *ascending*, with irregular or somewhat pinnate *erect branches; shining*, golden green, brown below. Stems *hardly radiculose*, about 2–4 inches long. Leaves crowded, erecto-patent, erect but not appressed when dry,

glossy, *deeply plicate*, resembling those of the last species, but rather larger, 1–1½ *lines long*, both margins usually recurved, *basal auricles somewhat less distinct, hardly toothed;* areolation similar, but the basal ones more incrassate, with the cell-walls distinctly porose. Perichaetial bracts longly acuminate, *sharply toothed* at the base of the acumen. Seta *rough*. Capsule inclined or almost erect, *slightly curved*, smaller and shorter than in the last, narrowly oblong or sub-cylindric, somewhat contracted below the mouth, orange-brown; lid acutely conical, narrow. Peristome small, yellowish; processes *well developed*, perforate along the keel; cilia *long*, very slender.

HAB. Dry hedgebanks, quarries, etc., principally in calcareous districts; often on sand dunes. Frequent.

Although much resembling *Camptothecium sericeum* in structural detail, the habit of this moss is so different that there is little difficulty in distinguishing it. The habitat is not the same, the present plant never growing on trees, and rarely on bare rocks or stones. The stems are very rarely creeping, usually more or less erect, so that the plant has a very different aspect; the branches are usually more robust, straighter, less terete when dry on account of the less appressed position of the leaves; and the leaves themselves are distinctly larger, being both longer and broader. It is quite distinct from *C. nitens* in the habitat, the colour, the absence of radicles, the rough seta, etc.; the absence of paraphyllia, narrower leaves and narrow basal areolation will also separate it from *Brachythecium plicatum* and *B. glareosum*. I have found it with exactly the habit of the latter plant, and only separable under the microscope. A prostrate form, turning black when old, with almost exactly the habit of robust forms of *C. sericeum*, occurs on limestone rocks in Derbyshire, and is difficult to separate from that species. It may be may the var. *fallax* Breidl. (*Homalothecium fallax* Philib.), but fruit is wanting for safe determination.

3. Camptothecium nitens Schp. (*Hypnum nitens* Schreb.; *H. trichoides* Neck., Braithw. Br. M. Fl.) (Tab. LII. E.).

Stems scattered among other mosses, or tufted, *erect*, tall, 2–5 inches high, *thickly coated with brown tomentum*, 2–4 times divided, with numerous spreading or ascending, somewhat pinnately or irregularly arranged branches; soft, bright shining green or often golden brown or reddish, *when dry with a glossy, almost metallic sheen*. Leaves densely crowded, very long, 1¼–1¾ lines, elongate-lanceolate, finely acuminate, narrowed from the base or a little above, *deeply plicate;* margin very narrowly revolute, *entire or faintly sinuose;* nerve very thin, reaching ¾ the length of the leaf; cells narrowly linear-vermicular, obtuse, incrassate, a few at extreme base shorter, very incrassate, with the walls strongly porose, at angles short, slightly wider, *but hardly distinct, and not forming defined auricles*. Perichaetial leaves *entire*. Seta *smooth*. Capsule inclined, oblong-cylindric, gibbous at back and arcuate, reddish brown.

HAB. Bogs and marshes, chiefly in sub-alpine regions, rare. Fruit very rare, summer.

A very beautiful species, easily known by the erect, almost dendroid stems, the shining texture, numerous radicles, etc. The absence of distinct angular cells also is an important character. The purple radicles which clothe the stems and even the branches frequently spring from the leaves themselves at the back of the nerve.

This moss, in common with some other more or less aquatic species has, as is evident from pleistocene deposits in several parts of England, been much more abundant in this country in prehistoric but postglacial times, when the climate was colder and the surface of the land much less drained than at the present day.

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108. **BRACHYTHECIUM** B. & S.

Primary stems not stoloniform, more or less prostrate, somewhat divided, with *irregular*, hardly pinnate branches. Leaves imbricated and straight or sub-secund, rarely falcato-secund, single-nerved more than half-way, *more or less widely ovate-acuminate*, often plicate; areolation widely or narrowly *rhomboid, somewhat lax at base*, usually rectangular and distinct at angles. Monoicous or dioicous. Seta rough or smooth. Capsule *inclined or horizontal, curved and usually gibbous at back, ovate or oblong, thick-walled;* lid *conical*, often acuminate, *not rostrate*. Peristome perfect, rarely imperfect.

The present genus is a fairly natural one, distinguished from Camptothecium by the leaves usually wider and more or less ovate at base, by the areolation which is shorter, wider, and rhomboid, becoming distinctly laxer towards the base, and by the shorter, more turgid, more solid capsule From Eurhynchium it is distinguished by the lid of the capsule not being rostrate, but at the most acuminate. I have united Scleropodium *B. & S.* with it; the areolation in that group of species is by no means longer, narrower, or more vermicular than in several species of Brachythecium, and the julaceous form of the branches is shared by *B. glaciale* and others. I have also followed Lindberg in associating with these *Hypnum purum* L., which differs from Scleropodium in no repect but in the smooth seta, a character of but slight, and admittedly not generic importance.

The British species have the leaves all straight, or at the most slightly secund and homomallous; a Canadian species has however the leaves distinctly falcato-secund, giving the plant a curiously Harpidioid appearance. The same remark applies to Camptothecium; as far as the European plants are concerned, the straight leaves afford a good distinctive character as compared with for instance *Hypnum uncinatum;* but I have received from the Rev. A. C. Waghorne a very pretty N. American moss,

apparently a form of *C. nitens*, which is very distinct in its falcato-secund leaves. Such plants would appear to indicate that the Harpidioid Hypna are less widely separated from the present groups than is usually supposed, and it may ultimately be found necessary to re-unite under Hypnum most of the genera as at present received, as was done by the earlier bryologists.

DERIV.—βραχυ-(brachy) short, and θηκιον (thēkion) a little vessel. From the short capsule.

1 { Ls. ovate-oblong, sub-acute or apiculate, not tapering, very concave 2
  { Ls. ovate-lanceolate or lanceolate, acute or acuminate 3

2 { Stem pinnate ; branches regular, in one plane ; seta smooth *16. purum*
  { Stem prostrate ; branches rather irregular, incurved ; seta rough *15. illecebrum*

3 { Ls. strongly plicate, long, with long slender acumen ; seta smooth (rough above in *campestre*) 4
  { Ls. not or less plicate, usually shorter ; seta rough 8

4 { Stem with paraphyllia ; ls. very deeply plicate .... *1. plicatum*
  { Stem without paraphyllia 5

5 { Autoicous or rarely synoicous ; ls. often serrulate above 6
  { Dioicous ; ls. nearly or quite entire 7

6 { Seta smooth throughout ....*4. salebrosum*
  { Seta smooth below, rough above ....*5. campestre*

7 { Stem ascending, cylindric with the imbricated, pale ls. *3. albicans*
  { Stem creeping ; ls. silky, with very slender, often twisted acumen *2. glareosum*

8 { Seta rough above, smooth below ; ls. often secund ....*13. plumosum*
  { Seta rough throughout (except sometimes in *B. populeum*) 9

9 { Stem-leaves with cordate base and decurrent wings and long fine points (alpine plants) 10
  { Stem-leaves not cordate, rarely decurrent 11

10 { Plant small and slender ; nerve reaching far into acumen *10. reflexum*
   { Plant larger ; nerve usually ceasing far below acumen .... *8. Starkei*

11 { Ls. nerved nearly to apex, narrow, with very narrow acumen *12. populeum*
   { Nerve ceasing some distance below apex 12

12 { Ls. with distinct auricles of hyaline cells 13
   { Auricles absent, or indistinct and greenish 14

13 { Dioicous ; ls. usually large and wide ; plant robust .... *7. rivulare*
   { Autoicous ; plant small ; ls. more or less imbricate .... *9. glaciale*

14 { Plant robust ; ls. widely ovate, over 1 line long *6. rutabulum*
   { Plant slender ; ls. under ¾-line long 15

15 { Ls. more or less imbricate ; branches few and slender .... *14. caespitosum*
   { Ls. divergent, often sub-secund ; branches numerous and short *11. velutinum*

1. Brachythecium plicatum B. & S. (*Hypnum plicatum* Schleich. *Ptychodium plicatum* Schp., Syn. ; *Lesquereuxia plicata* Lindb., Braithw. Br. M. Fl.) (Tab. LII. F.).

Robust, dull yellowish green or brownish. Stems creeping, divided, 2–5 inches long, rather rigid ; divisions prostrate,

somewhat pinnately branched, the branches stout, *not attenuated*, sub-terete when dry, erect or ascending. Leaves closely imbricated, erecto-patent or slightly sub-secund, large, about 1 line long, *rapidly and longly acuminate from a wide, ovate base, deeply plicate, interspersed with numerous, multiform paraphyllia ;* margin *entire*, widely revolute ; *nerve strong, reaching into the acumen*. Cells narrowly linear-rhomboid, somewhat vermicular, *8–15 times as long as broad*, towards base slightly shorter and wider, at extreme base short, incrassate, with the walls porose ; at angles *rather large, sub-quadrate*, opaque, numerous. Seta *smooth*. Capsule horizontal or inclined, oblong, arcuate ; lid acutely conical. Inner peristome without cilia. *Dioicous*.

HAB. Alpine calcareous rocks. Very rare ; the Ben Lawers range of mountains. Fruit very rare, autumn.

There is little difficulty in identifying this moss, as the allied species with strongly plicate leaves are all found in different habitats ; the leaves also are wider and more suddenly acuminate, and the plicae more irregular, than in Camptothecium ; and the paraphyllia, the long nerve, and the narrow, elongated cells separate it from all the similar species of its own genus. It has some resemblance to *Antitrichia curtipendula*, which is known by its toothed leaves and the absence of paraphyllia.

B. plicatum varies somewhat in the size of its parts, but there are no important varieties.

2. Brachythecium glareosum B. & S. (*Hypnum glareosum* Bruch, Braithw. Br. M. Fl.) (Tab. LII. H.).

In its most robust forms resembling *B. plicatum*, but less rigid, in its more slender ones *B. salebrosum* and *Camptothecium lutescens ;* stems *creeping*, often very long, sometimes 6 or 8 inches, but more frequently much shorter, flexuose, *silky, soft ; branches ascending or depressed*, rather distant, irregularly pinnate, terete or slightly flattened. In straggling patches, *pale whitish green, shining*. Leaves somewhat crowded, *1¼–1¾ lines long*, from a wide, *ovate-lanceolate* base, gradually or rather rapidly narrowed to an *almost filiform, twisted acumen, deeply plicate*, slightly decurrent ; margin revolute just above the middle, entire at base, entire or slightly denticulate in the acumen ; nerve wide at base, soon becoming narrow, vanishing *about the middle of the leaf*. Cells elongated, linear-rhomboid, thin-walled, 8–12 times as long as broad, chlorophyllose, towards base wider and rather shorter, often markedly laxer, the walls thin, hardly porose ; angular cells rather numerous, sub-rectangular, somewhat large and pellucid. Seta *smooth*. Capsule small, oblique, arcuate. Lid conical, acute. *Dioicous*.

HAB. Calcareous banks, quarries, rocks on mountains, etc., not uncommon. Fr. very rare, winter.

In its ordinary lowland form *B. glareosum* is known by its prostrate, sub-pinnate stems with distant, silky, soft branches, and the leaves ending in a very long, twisted, filiform acumen. On mountain rocks it is generally much more robust. Sometimes the branches are more crowded, erect and slender, when the plant resembles *B. albicans*. It is then known by the less concave, less imbricated, more deeply plicate, denticulate leaves, with the areolation usually longer. *B. salebrosum* differs in the autoicous inflorescence, the smaller leaves with shorter, hardly twisted acumen, fainter plicae, etc.; *B. campestre* in the autoicous inflorescence, the leaves less acuminate, the seta slightly rough. Camptothecium differs in the narrow basal areolation.

3. Brachythecium albicans B. & S. (*Hypnum albicans* Neck., Braithw. Br. M. Fl.) (Tab. LII. G.).

Stems ascending, branches *erect, crowded, slender, terete and often julaceous*, often curved at the tips; in dense tufts, pale yellowish or whitish green, more rarely bright green; 1–3 inches high. Leaves *densely imbricated, when dry closely imbricated* with the points divergent, sometimes sub-secund, concave, plicate, *of thin texture*, widely ovate, *abruptly or more gradually piliferous*; margin plane or slightly recurved at base, *entire*, rarely superficially denticulate at apex, nerve reaching to the middle; cells variable in width, linear-rhomboid, usually 8–10 times as long as broad, pellucid, much laxer towards base, at angles sub-quadrate, somewhat opaque, *forming a narrow but rather long marginal band*. Seta *smooth*. Capsule small, shortly oval. *Dioicous*.

Hab. Stony places, wall-tops, etc., on siliceous soil; common. Fr. rare, winter and early spring.

A more slender plant than either the preceding or *B. salebrosum*; usually readily known by the julaceous imbrication of the leaves, which are more abruptly acuminate, almost always entire, of thin texture and sometimes almost hyaline. *B. glareosum* at times somewhat simulates it, but may then be known by the more gradually and more longly acuminate, usually denticulate leaves.

4. Brachythecium salebrosum B. & S. (*Hypnum salebrosum* Hoffm.; *Hypnum plumosum* L., *non* Swartz, Braithw. Br. M. Fl.) (Tab. LII. I.).

Intermediate in habit and vegetative structure between *B. rutabulum* and *B. glareosum*, and, like the former, very variable. The leaves are usually *narrower* than in typical *B. rutabulum*, less decurrent, somewhat deltoid-lanceolate, *gradually tapering to a rather long, fine acumen*, but not so long as in *B. glareosum*, often sub-secund, hardly concave, or somewhat concave-carinate at base, *more or less deeply plicate*, denticulate all round, or almost entire, margin plane or recurved; nerve thin, reaching about half-way or to the base of the acumen; areolation as in *B. rutabulum*. Seta *smooth*, usually rather long, but variable. Capsule oval-oblong, somewhat turgid at back, curved; annulus narrow. *Autoicous*.

Var. *β. palustre* Schp. (var. *Mildei* Kindb., Braithw. Br. M. Fl.; *Hypnum Mildeanum* Schp.). *More robust* and less branched, *more erect*, with larger, *broader*, *cordate-triangular* leaves, erect, not sub-secund, *more rigid*, *less plicate*, *more shortly acuminate*.

HAB. About the roots of trees, the foot of rocks, on stones, etc.; rare. The var. *β* in damp clayey fields, etc.; rare. Fr. autumn.

The essential characters of this species are the quite smooth seta, by which it is distinguished from *B. rutabulum* and *B. campestre*, and the autoicous inflorescence, separating it from *B. glareosum* and other dioicous species. It is also usually a more silky plant than *B. rutabulum*, with narrower, more shining, more plicate leaves, with longer acumen, though shorter than in *B. glareosum*. It is however a very variable plant, and some forms approach *B. rutabulum* so closely that it is doubtful whether barren plants may be always safely referred to one or the other, especially as the paludal form of *B. rutabulum*, which most nearly approaches the present species in its narrower, more acuminate leaves than in the type, is most frequently barren. *B. salebrosum* is however, as Spruce pointed out, a very fertile species, the flowers being almost always to be found in great abundance. The var. *palustre* (usually cited as var. *Mildeanum*) is a marked form, by Lindberg and others, as by Schimper himself formerly, considered as a species; but the characters by which it is distinguished are somewhat inconstant, different writers often disagreeing as to certain points of structure; nor, although conferring a different appearance on the plant, are they of great importance.

Both male and female flowers are almost always to be found in abundance throughout the year. Synoicous flowers are sometimes, but exceptionally, present.

5. Brachythecium campestre B. & S. (*Hypnum campestre* Bruch, Braithw. Br. M. Fl.) (Tab. LII. J.).

Resembling *B. salebrosum*, with the leaves usually slightly more erect and imbricated, but not constantly so. Seta *smooth at base, slightly rough above. Autoicous.*

HAB. Stony and grassy places, very rare. Fr. autumn and winter.

There is practically no difference between this plant and *B. salebrosum* except the slightly rough seta, and it is questionable whether it should not be more properly considered a sub-species or variety of that plant; the possibility also suggests itself whether it may not be a hybrid between that and *B. rutabulum*; but the plant is hardly sufficiently known at present to warrant such a conclusion. It will not be confounded with *B. rutabulum*, on account of the silky, plicate, longly acuminate leaves, as well as the much less highly papillose seta, but from *B. salebrosum* it could hardly be distinguished without fruit.

6. Brachythecium rutabulum B. & S. (*Hypnum rutabulum* L., Braithw. Br. M. Fl.) (Tab. LIII. A.).

A very variable plant; stems creeping, somewhat radiculose, divided; branches irregular, sometimes sub-pinnate, erect or ascending, curved, *robust*; forming large loose tufts of a *bright*

or deep glossy green. Leaves *large, cordate-ovate, or deltoid, shortly and acutely acuminate;* more rarely longly ovate-lanceolate and more longly acuminate; rather loosely placed, *somewhat divergent both wet and dry*, not, or rarely, erect and imbricated; usually somewhat concave; more or less *decurrent*, sometimes strongly so, *faintly plicate*, especially when dry; margin plane or slightly reflexed, finely denticulate usually nearly all round; nerve thin, narrow, except at the base, reaching halfway or rather more. Cells *acutely linear-rhomboid*, sometimes slightly vermicular, *very narrow*, variable in length, *usually 15–20 times as long as broad*, but sometimes shorter; towards base gradually becoming shorter and wider, but in a very variable degree, at extreme base wide, oval-hexagonal, the walls somewhat porose; at angles *wide, sub-quadrate-oval, rather obscure*, forming larger or smaller but *not well-defined nor hyaline auricles*. Perichaetial bracts nerveless, longly and finely acuminate, squarrose. Seta *strongly papillose*, robust, variable in length, usually about 1 inch; capsule rather large, oval-oblong or sub-cylindrical, gibbous at back, arcuate, dark reddish brown; lid conical, short and obtuse or longly acuminate; annulus broad; peristome large. *Autoicous.*

HAB. On earth, walls, trees, etc. Very common. Fr. winter.

With all its variations, this is as a rule not a difficult plant to recognise, except in those barren forms which are mentioned above as somewhat approaching *B. salebrosum;* these are chiefly paludal. The rather coarse, broad, rigid leaves, glossy or scariose but hardly silky, almost always more or less spreading even when dry, give it a characteristic appearance. It is often found barren, but is quite common in fruit, which it frequently produces in great profusion; and the seta, rough throughout all its length, at once identifies it; all the other British species of the genus, wxcept *B. rivulare*, which have this character, being of quite different habit. *B. rivulare* is dioicous, and is almost always known by its shortly and widely pointed, decurrent leaves with very lax basal areolation and well-defined auricles. Forms do occur, but rarely, with the leaves scarcely distinct from those of *B. rivulare;* they can then only be distinguished by the inflorescence. *B. salebrosum, B. campestre*, and *B. glareosum* have almost always narrower, silky leaves, more deeply plicate and longly acuminate. *B. Starkei* has much shorter and wider cells, strongly decurrent leaves, etc.; *B. velutinum* is much more slender.

Several varieties have been described, the var. *longisetum* B. & S. being one or the most marked, being of looser growth, with long stems bearing narrower more distant leaves, and longer setae. The var. *robustum* B. & S. has erect, stout branches, with densely crowded, very wide, markedly plicate leaves. The var. *plumulosum* B. & S. resembles *B. salebrosum*, having very narrow, longly acuminate leaves. None of these varieties however have their limits very clearly defined. Many allied species have recently been described from N. America, but several of these have been reduced to synonyms by Dr. Grout in his Revision of the genus (Memoirs of the Torrey Bot. Club, 1897).

B. rutabulum is by far our commonest species, and very abundant.

7. Brachythecium rivulare B. & S. (*Hypnum rivulare* Bruch, Braithw., Br. M. Fl. ; *H. amoenum* Stirt. in Ann. Scot. Nat. Hist. ix, 180) (Tab. LIII. B.).

Resembling *B. rutabulum* and almost equally variable ; robust, usually *paler*, often golden green, shining, more rigid, *with longer branches*. Leaves *more erect and more regularly imbricated when dry*, those of the stems usually widely ovate-triangular, *shortly and rather widely, not finely acuminate, sometimes only sub-acute* (those of the branches narrower and more longly acuminate), concave, *widely decurrent*, rigid and sub-scariose, *more or less deeply plicate ;* margin plane or slightly revolute at base, denticulate ; upper cells as in *B. rutabulum*, or frequently shorter and much laxer, the basal *laxer, wide*, usually with incrassate, highly porose walls, *at decurrent angles large, pellucid, forming rather well-defined, sometimes hyaline auricles*, in the older leaves frequently orange-brown. Seta strongly papillose ; capsule usually rather short and turgid. *Dioicous*.

Var. β. *latifolium* Husn. (non *Hyp. latifolium* Lindb.). Secondary stems *erect, slender, little branched*, cuspidate ; usually of a deeper green, *soft in texture ;* stem-leaves very *broad, longly decurrent with distinct, often orange, auricles*.

Var. γ. *tenue* Dixon, Handb. Ed. I. *Very slender, yellowish, almost prostrate, branches short*, often curved at the tips ; leaves, especially the lower ones, *distant, widely spreading when dry, small*.

Var. δ. *chrysophyllum* Bagnall, Handb. Ed. I. *Slender*, usually *yellowish green ;* leaves *glossy*, scariose, *strongly plicate ;* margin reflexed.

HAB. Rocks and stony places by streams ; often submerged. Frequent. The var. *latifolium* in alpine streams, rare. The var. *tenue*, Fairlight Glen, Hastings (*Jameson*). The var. *chrysophyllum* not uncommon. Fr. autumn, rare.

In addition to the dioicous inflorescence, this species differs from *B. rutabulum* in the more shortly, widely pointed leaves with laxer pellucid basal and angular cells, usually exhibiting distinct, decurrent auricles ; the leaves are usually also more plicate, more erect and regularly imbricated when dry, less flexuose and spreading ; the plant is however very variable in size and habit, as well as in form of leaf.

The var. *latifolium* Husn. is a fairly distinct one, but it appears to be a different plant from *H. latifolium* Lindb., which has more longly pointed leaves, not plicate, with margin recurved below.

The plant described in the first edition of this work as var. *tenue* is a very marked one, but it is possible that it is only an exceedingly slender, attenuated form, and perhaps not of more value than several other varieties too numerous to be fully described. Among these is the var. *cataractarum* Sauter, a large aquatic form with long, little branched stems, often of a dark coppery hue, with large, broad leaves. Another variety or, more properly, form has the leaves secund and regularly turned to one side (f. *homomalla*).

The var. *β* is a pretty golden form, of soft texture. It was first described by Mr. Bagnall as var. *chrysophyllum* Spr., from an inedited herbarium name of Spruce's. The name *chrysophyllum* was however an error in transcription, Spruce having written *chrysoleucon*; Dr. Braithwaite considers that the differences between Spruce's plant and the Cannock Chase plant on which Mr. Bagnall's variety was founded are sufficient to allow the latter being maintained as an independent variety, and Mr. Bagnall's name may therefore be retained.

8. Brachythecium Starkei B. & S. (*Hypnum Starkei* Brid. and *H. curtum* Lindb., Braithw. Br. M. Fl.) (Tab. LIII. C.).

Stems *slender*, creeping, radiculose, branches somewhat pinnate, *short, distant*, ascending, curved, *slender*; forming intricate low patches. Leaves *rather loosely arranged, spreading and divergent, not closely imbricated*, often secund, *widely cordate-triangular*, or broadly ovate on the branches, shortly and rather abruptly, but finely acuminate; *not or rarely plicate; strongly and widely decurrent*; nerve reaching nearly $\frac{3}{4}$ of the leaf, occasionally far into acumen; margin denticulate, or sharply serrate, especially above; cells shorter and wider than in *B. rutabulum*, narrowly hexagonal-rhomboid, *6–12 times as long as broad*, rarely more elongated, *often still shorter and wider*; at angles numerous, large, sub-rectangular, pellucid. Seta rough. Perichaetial bracts finely acuminate, *squarrose*. Capsule *small, shortly oval*, turgid, blackish when ripe. Cilia of inner peristome *with appendages*. Autoicous.

Hab. Mountain rocks in woods, etc. Very rare; only on one or two mountains in Scotland. Fruit rarely found in Britain, autumn.

A somewhat variable moss, in size especially, but always more slender than any of the previous species; and usually at once distinguishable from them and the succeeding ones (except *B. glaciale*) by the widely cordate leaves, strongly decurrent, very spreading or even squarrose at the points, not imbricated even when dry, and by the wide areolation, which is often extremely lax, rendering the leaves (for this genus) very soft and pellucid. The capsule also is very small and dark coloured. It is much more difficult to separate, however, from *B. glaciale*. The leaves in that are plicate, but even in the present species some of the leaves may often be seen to be decidedly plicate, especially when dry; in *B. glaciale* they are narrower, ovate-acuminate, not cordate-triangular, but some forms of the present species have the leaves distinctly more ovate than in the type; the loosely imbricated, spreading leaves form on the whole the best character of *B. Starkei*, as compared with the closely imbricated, julaceous leaves of the succeeding species.

B. reflexum differs in the more slender stems, usually forming denser, neater tufts, with the nerve reaching nearly to the apex of the leaves. The nerve in *B. Starkei* is occasionally, though rarely, prolonged in the same way, as mentioned by Limpricht. I have found it so on a specimen collected on Craig Chailleach by J. Hunter.

9. Brachythecium glaciale B. & S. (*Hypnum glaciale* Hartm., Braithw. Br. M. Fl.) (Tab. LIII. D.).

Much resembling *B. Starkei ;* differing in its short, *obtuse, julaceous branches*, with the leaves *closely imbricated, not spreading nor distant, narrower, widely ovate-lanceolate, not cordate*, decurrent, *plicate ;* branch-leaves narrower and more longly acuminate ; areolation as in that species. Perichaetial bracts imbricated, *erect*. Seta short, rough. Capsule shortly oblong, turgid. Cilia of inner peristome *nodulose, rarely appendiculate*. Autoicous.

HAB. High alpine rocks, near the snow-line ; extremely rare. Perthshire ; Aberdeenshire. Fr. summer.

Husnot records the var. *subsecundum* from Ben Lawers ; it is a rather laxer form with the leaves less closely imbricated, and sub-secund. Limpricht, however, describes it as a new and distinct variety, var. *Huntianum*, but the characters of this and other varieties described appear to me very elusive and hard to grasp.

B. glaciale is, as mentioned under the preceding species, somewhat difficult to separate from that moss ; but in well marked forms the densely imbricated leaves, rendering the branches julaceous, and themselves of a different form, will identify it. There is however very great discrepancy in the descriptions of these two species by different authors, and it seems almost impossible to form a clear conception of their distinguishing characters. I find it most difficult to grasp the distinctions in Limpricht's descriptions, and it should be pointed out that the characters given in his key are entirely at variance with the figures and descriptions given later. The well-marked forms of *B. glaciale*, as I gathered it about the snow-line in Norway and the Pyrenees, are very distinct in the terete, julaceous branches with erect, striate leaves, from the ordinary forms of *B. Starkei*, in which the leaves are much looser, not appressed nor julaceous, and the habit is more straggling. The apparently clear distinction vanishes however when one comes to examine a series of plants, and is compelled to recognise the existence of intermediate forms. When in fruit the perichaetial bracts, erect in *B. glaciale*, spreading at the points in *B. Starkei*, appear to give a good distinguishing character.

I have gathered *B. Starkei* on Ben Lawers in some quantity, and in numerous forms, some with the leaves appressed and julaceous, recalling *B. glaciale*, and perhaps referable there ; but I have seen no undoubted specimens of the latter species from that locality. A plant however gathered by the Rev. A. Ley in Aberdeenshire in 1876, is I think certainly *B. glaciale*.

10. Brachythecium reflexum B. & S. (*Hypnum reflexum* W. & M., Braithw. Br. M. Fl.) (Tab. LIII. E.).

In dense, *intricate, low patches ; very slender*, dark green. Stems slender, prostrate, divided, with somewhat pinnate, *short, delicate, often curved branches*. Stem-leaves *cordate, rapidly acuminate to a rather long, fine, often twisted point*, branch-leaves narrower, ovate-lanceolate, more gradually acuminate, closely set, when dry somewhat spreading and divergent or closely imbricated so as to render the branches filiform and somewhat julaceous ; all *strongly decurrent*, denticulate nearly all round, smooth or faintly plicate, margin plane or very narrowly recurved ;

nerve distinct, *reaching nearly to apex or at least high up in the acumen ;* areolation *short, with the walls firm and rather incrassate,* narrowly rhomboid, slightly obtuse, *5–8 times as long as broad ;* gradually becoming shorter and wider towards base—except near the nerve—at angles *large,* quadrate-rounded or slightly elongated, pellucid, forming large, but not clearly defined auricles. Seta slender, short, about $\frac{1}{2}$ inch in length, *rough ;* capsule *very small,* oval-oblong, curved ; lid small, apiculate. *Autoicous.*

HAB. Trunks of trees and rocks on mountains ; very rare ; on one or two of the higher mountains of Scotland. Fr. winter.

This is one of the most delicate species of the genus, and not to be confounded with any of the preceding ones except possibly slender forms of the last two, from which however the long nerve and the firmer, neat areolation will at once distinguish it. It is more like *B. populeum* and *B. velutinum,* the latter differing in the shorter nerve, the former in the narrower, longer, more gradually tapering leaves.

It also has some resemblance, both in habit and areolation, to *Amblystegium serpens* and *A. varium ;* the former differs in the short faint nerve, the latter in the almost entire leaves, and both in the shorter, laxer, very obtuse areolation, and the habitat is usually very different.

B. reflexum is extremely variable in size, and the direction of its leaves.

The var. *micropus* Braithw. (*B. micropus* B. & S.) is a curious form with small, tapering leaves but large capsules, covered entirely by the calyptra, the seta only slightly rough, and the peristome teeth perforate at apex. It has been suggested that it may be a hybrid with *B. populeum.* It is recorded from Ben Lawers.

11. Brachythecium velutinum B. & S. (*Hypnum velutinum* L., Braithw. Br. M. Fl.) (Tab. LIII. F.).

Slender, in usually *dense, low, silky tufts,* bright or yellowish green. Stems prostrate, branches numerous, *short, close,* straight or curved, irregular or sub-pinnate. Leaves erecto-patent or sub-secund, when dry usually widely spreading and distant, sometimes more erect and closely imbricated ; *small, narrow, ovate-lanceolate or lanceolate, tapering to a narrow point,* finely or strongly denticulate all round, very faintly plicate at base, very shortly decurrent, *glossy when dry ;* margin often recurved at base ; nerve slender, not reaching much above half-way up the leaf ; cells narrow-linear, rather obtuse, 8–12 times as long as broad, *somewhat opaque,* slightly shorter and wider at base, not pellucid ; angular few, irregularly quadrate, opaque. Perichaetial bracts *sub-erect, very finely acuminate.* Seta *strongly papillose,* variable in length, usually rather short, $\frac{1}{2}$–$\frac{3}{4}$ inch ; capsule small, turgidly oblong, gibbous at back, or longer, narrowly oblong and arcuate ; lid acute or acuminate ; peristome large. *Autoicous.*

HAB. Roots of trees, rocks, etc. Common in the eastern and midland counties ; much less common in the west and north. Fr. winter.

Very variable, but usually not difficult to recognise in the field, by its small size, small and narrow, silky, but not distinctly plicate leaves ; these are usually spreading when dry, giving the branches a very different appearance from those of *B. populeum*, which has them commonly more terete from the closer imbrication of the leaves ; this however sometimes is the case with the present plant, and it then resembles slender forms of *Camptothecium sericeum*, which of course, however, is very different in the plicate leaves, etc. There is often a resemblance to *Eurhynchium confertum*, but that plant has less tapering and less silky leaves, and a long-beaked fruit.

Several varieties are described ; the var. *praelongum* B. & S., a marked form with setae over an inch long and elongated stems is probably British. The var. *intricatum* Hedw. appears to be only a somewhat marked form of a very common state of this species, and to be connected with the type by numerous and widely spread links.

The leaves are more opaque than in most of the previously described species of the genus.

An allied, alpine species, *B. trachypodium* B. & S., has been recorded from Ben Lawers, but on unsatisfactory evidence (see Journ. of Bot. 1914, p. 123). Geographically, however, it might well occur there.

12. Brachythecium populeum B. & S. (*Hypnum populeum* Hedw. ; *H. viride* Lam., Braithw. Br. M. Fl.) (Tab. LIII. G.)

Slender, in small dense patches, of a bright or more commonly yellowish green ; stems procumbent, divided, with *numerous, pinnately arranged, erect or curved branches*, which are *slender*, and *more or less terete or cylindrical* when dry. Leaves *closely imbricated and erect when dry*, or slightly homomallous ; stem-leaves *ovate-lanceolate*, branch-leaves narrower, *lanceolate ; all gradually tapering to a fine, elongated acumen ;* hardly plicate, shortly decurrent ; margin more or less recurved, in upper half finely denticulate ; nerve *strong, very long, reaching nearly to apex ;* cells narrow-linear, rather acute, 6–12 times as long as wide ; at base wide, irregularly rectangular, those at the angles more numerous, reaching higher in the leaf, somewhat opaque, often yellowish. Seta *rough, usually almost smooth at the base ;* perichaetial leaves *squarrose*. Capsule small, oval, gibbous at back ; lid shortly acuminate. *Autoicous*.

Var. *β. majus* B. & S. *More robust*, golden yellow, leaves *larger*, longer, straight.

HAB. Sandy ground, walls, etc., not uncommon, in some districts frequent. The var. *β* rare. Fr. winter.

The narrow, silky foliage, erect and imbricated when dry, and longly acuminate, gives this species a characteristic aspect by which it may generally be known, much resembling in miniature that of *Camptothecium sericeum*. It is markedly distinct, too, from nearly all the Hypnaceae in the narrow, gradually and longly tapering leaves, with the nerve reaching nearly to apex. *Pseudoleskea striata* differs in the short cells and numerous paraphyllia ; *Eurhynchium tenellum* in the much more slender habit, very short branches and still narrower leaves, besides the rostrate lid ; and *Hypnum elodes* in the slender habit and distant, spreading leaves.

13. Brachythecium plumosum B. & S. (*Hypnum plumosum* Swartz ; *H. pseudoplumosum* Brid., Braithw. Br. M. Fl. ; *Isothecium symmictum* Stirt. in Ann. Scot. Nat. Hist. ix, 179) (Tab. LIII. H.).

In large dense patches, *robust ;* stems prostrate, 2–3 inches, with densely pinnate branches, *erect or curved, stout, somewhat tumid with the closely imbricated, concave leaves ;* bright shining green, often tinged with golden brown. Leaves crowded, erecto-patent when moist, more imbricated when dry, *almost always more or less homomallous, frequently strongly falcato-secund, very concave ;* when dry often somewhat involute at margins, glossy and somewhat striate ; large, those at the middle of the branches $\frac{3}{4}$-1 line long, *widely ovate-oblong,* somewhat narrowed and often asymmetrical at the base, rapidly and shortly acuminate or apiculate, *the point usually oblique ;* margin plane, finely denticulate ; nerve rather strong below, reaching about $\frac{3}{4}$ of the length of the leaf ; cells very narrow, linear-vermicular, not pointed, the walls firm, 10–15 times as long as wide ; shorter and looser at base ; the angular few, sub-quadrate, not forming defined auricles, yellowish. Leaves at the summit of the branches narrower, more gradually and longly acuminate. Perichaetial bracts *erect, sheathing.* Seta *slightly papillose in the upper half only, short,* $\frac{1}{2}$–$\frac{3}{4}$ inch. Capsule oval-oblong, turgid, dark ; lid acute. *Autoicous.*

Hab. Rocks in and near streams, especially where at times submerged. Frequent. Fr. winter.

The var. *homomallum* B. & S. is described as having the leaves falcato-secund, and the branches often curved. This form, in a marked degree, occurs occasionally with the type, but it is only the extreme of a number of common forms with the leaves more or less secund ; it is indeed rare to find this species with the leaves perfectly imbricated and not in some degree homomallous ; and this character, and the shining, concave, shortly pointed leaves, are sufficient as a rule to identify the plant at sight. In colour and aspect it sometimes resembles *Hypnum eugyrium,* with which it often grows, and I have more than once had specimens of the present plant sent me labelled as that species ; apart from microscopical examination, however, there is almost always a greater acuteness of leaf and of branch which will distinguish this species from that. In its robust states it sometimes also resembles *B. rivulare,* but the leaf is very different in form.

The fruit is usually produced in great abundance, and the seta, smooth in the lower half or even to above the middle, is one of the distinctive characters of the species.

It appears probable that the specific name *plumosum* has been wrongly attributed to this species, and was originally given to quite a different moss, viz., the one usually known and described above as *B. salebrosum,* in which case the earliest specific name for the present species would be *B. pseudo-plumosum ;* there appears however to be still some little uncertainty on the matter, and the established name of *B. plumosum* should be retained for the present.

14. Brachythecium caespitosum Dixon (*Hypnum caespitosum* Wils., Braithw. Br. M. Fl.; *Scleropodium caespitosum* B. &. S., Schp. Syn.) (Tab. LIII. I.).

In low soft tufts or patches, of a bright, often silvery green, secondary stems and branches ascending, *curved, slender, crowded, acute, julaceous;* leaves erecto-patent, when dry erect and imbricated, frequently sub-secund; *concave,* not plicate, *small, oval-oblong, with a rather abrupt point or acumen of varying length;* branch-leaves narrower, with shorter points; margin plane or almost so, denticulate in upper part, nerve strong at the base, reaching above half-way, often forked, frequently projecting at tip from the back of the leaf as in the next; cells *narrow, linear-vermicular,* 8–12 times as long as wide, shorter and broader at apex; wide, rectangular-oval, distinct at basal angles, opaque or pellucid. Seta *rough.* Capsule *sub-erect or inclined, narrowly oblong,* often curved; lid conical, acuminate. *Dioicous.*

HAB. Stones, foot of trees, etc., not common. Fr. rare, winter.

A somewhat difficult plant to determine, owing to the rarity of its fruit and the similarity it bears to one or two other mosses, notably to *Eurhynchium crassinervium* and *E. murale.* The former is a more robust plant, with less julaceous branches, shorter cells, stouter nerve, and longly rostrate lid; *E. confertum* and *E. murale* are autoicous, and being generally fertile are readily distinguished by the long beak of the lid; the latter also differs in the still more concave, very shortly pointed leaves and short nerve, and the former in the leaves not being imbricated nor julaceous. In some of its forms it very closely resembles slender states of *E. myosuroides,* indeed the branch-leaves in the two plants are at times scarcely if at all distinguishable from one another; the present species however has the branches distinctly more terete and julaceous, while it is without the distinct, broader stem-leaves of the other plant. The slender, more or less julaceous, curved branches with very concave leaves are the characteristic features of this plant. It somewhat resembles a miniature form of *B. plumosum.* There appears to me no sufficient reason for separating this plant, and with it the two following species, from *Brachythecium.* The areolation, mainly on the ground of which it was separated by Bruch and Schimper, differs in no respect from that of other species of the genus, nor is the julaceous arrangement of the leaves different from that of several species.

The capsule indeed in the present species is somewhat long and narrow for the genus, but it is quite equalled in that respect by others, such as *B. laetum* B. & S.; and that of the following species is quite normal. On the whole it appears to me a much more natural arrangement to unite these species with the present genus, with which they closely agree in the areolation, as well as in the short lid, and the form of the capsule.

15. Brachythecium illecebrum De Not. (*Hypnum illecebrum* Schwaeg., Braithw. Br. M. Fl.; *Scleropodium illecebrum* B. &. S.) (Tab. LIII. J.).

Nearly allied to the last, differing in habit; *the branches more tumid, obtuse, very julaceous, shorter;* forming loose low tufts of a bright green. Leaves *very concave, very widely oval,*

wide at apex and suddenly contracted to a short point, slightly decurrent at base, very soft in texture, closely imbricated when dry, denticulate ; nerve reaching about $\frac{3}{4}$ the length of the leaf, sometimes forked ; ending rather abruptly, and frequently projecting at its tip from the back of the leaf in a spiculose point. Areolation narrow, linear-vermicular, 10–12 times as long as wide, a little longer than in the last ; angular cells few, lax. Seta *very rough ;* capsule *shorter, oblong, sub-horizontal,* slightly turgid ; lid apiculate. Dioicous.

Hab. On the ground, and among earth on rocks, not common, and usually barren ; most frequent in the west and south, especially near the sea. Fr. winter.

This is a southern species, and only fruits freely about the Mediterranean. It is however not a difficult plant to identify, the tumid, julaceous branches, with very wide, concave, abruptly pointed leaves, being very different from what is found in most of the allied species. The preceding one differs in the more slender, acute branches, the narrower, less abruptly pointed leaves, etc. ; the next in the taller habit, more robust and longer stems and branches, smooth seta, and other points ; *Eurhynchium murale* in the narrower leaves, shorter nerve, long-beaked lid and smooth seta.

In some localities in the West of England this species and the preceding and *Eurh. crassinervium* frequently occur together ; the latter is known by the branches in the dry state much less terete and julaceous, the longer points of the leaves being reflexed and the leaves themselves more altered in drying ; in both the former species the branches are curved and terete, but much more slender, less rigid, longer and less julaceous in *B. caespitosum.*

16. Brachythecium purum Dixon (*Hypnum purum* L., plur. auct.) (Tab. LIII. K.).

In loose, wide, soft patches, *pale bright green, yellowish or dirty white ;* stems *robust,* long, 2–6 inches, prostrate or ascending, simple or slightly divided, with *numerous, complanate, more or less regularly pinnate branches ;* stems *tumid with the crowded, concave leaves ;* branches *julaceous, tumid, obtuse.* Leaves large, *very wide and concave,* 1–1¼ lines long, *plicate,* much resembling those of the last species ; *wide at apex with a short abrupt apiculus* which is often reflexed ; margin recurved just above the base, above plane or involute, finely denticulate all round ; nerve short, reaching about half-way, thin above, rather wider at base ; cells narrow, *linear-vermicular,* 10–18 times as long as wide, obtuse, the walls firm and somewhat incrassate ; at extreme base wide, oval, with incrassate, very porose cell-walls ; angular few, sub-quadrate, forming very indistinct auricles. Perichaetial bracts erect, imbricated, longly acuminate. Seta *smooth, slender,* flexuose, *long,* 1–2 inches ; capsule horizontal and decurved, oblong or sub-cylindric, often gibbous at back ; lid conical, acutely acuminate. Dioicous.

HAB. In grass in woods, on banks, etc. Abundant. Fruiting rarely, in spring.

A very distinct species, often very large and robust; known at sight by its tumid obtuse stems and branches, with wide, inflated, obtuse leaves; it has usually been placed near *Hypnum Schreberi*, which in its slender forms it occasionally resembles, but from which its pale, not red, less erect stems, single nerve, and usually obtuse branches will separate it. Its habit is quite different from the last, to which however in structural details it is closely allied; but that has slender, prostrate, hardly leafy stems with the branches erect or ascending, while here the stems are robust, leafy, with pinnate, complanate branches; and the seta is smooth and much longer. A form occurs however with much more of the habit of that plant, having very tumid more erect branches and large wide leaves.

B. purum is one of our very common species, and is the one frequently employed by anglers for scouring worms.

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109. HYOCOMIUM B. & S.

Growing on wet rocks. Secondary stems *regularly or irregularly pinnately branched.* Leaves *widely cordate;* nerve *double, short and faint;* areolation almost uniform throughout the leaf, *linear-vermicular,* laxer at base. Paraphyllia present, not numerous. Seta *rough;* lid conical, acuminate; peristome perfect. Dioicous.

A genus of a single species, clearly distinguished by the wide leaves with short double nerve and the rough seta.

DERIV.—The authors of the Bry. Eur., by whom the name was conferred, give the derivation as from ὑοκομιος (hyokŏmios) a lover of moisture; alluding to the habitat of *H. flagellare.*

1. Hyocomium flagellare B. & S. (*Hypnum flagellare* Dicks.) (Tab. LIII. L.).

Stems elongated, 3–8 inches long, prostrate or pendulous, usually simple or twice or thrice divided, unbranched below, above with numerous more or less regularly pinnate and complanate branches, or fewer, more elongated and parallel; branches straight or curved, often long and attenuated, terete; forming wide dense tufts or mats, of very soft texture, of a bright, or more frequently golden, green. Stem-leaves imbricated, erecto-patent, *widely cordate-triangular* from an excavate, semi-amplexicaul base, *abruptly acuminate to a fine, somewhat flexuose acumen,* which is often squarrose; branch-leaves narrower, more closely imbricated, less abruptly acuminate, often nerveless, *usually densely imbricated, rendering the branches terete,* sometimes secund. Leaves somewhat plicate, margin plane, somewhat

undulate, sharply serrate with distinct, slightly squarrose teeth almost all round; nerve *double, very short and faint*, rarely short and single, indistinct. Cells *linear-vermicular*, more or less obtuse, 10–15 times as long as broad, the walls often porose; at base shorter, rather wider, especially at basal angles, where they are often widely rhomboid-hexagonal; but *not quadrate, obscure, nor forming defined auricles*. Perichaetial bracts with long flexuose points; seta *very rough*, hardly an inch long; capsule rather large, widely oblong, gibbous, thick-walled, inclined.

Hab. Rocks in and near streams and waterfalls, frequent. Fruit very rare, autumn.

A very variable moss, but usually with a soft, feathery habit, which with the imbricated, wide leaves is sufficient to identify it; the fruit is very rare, and the rough seta—one of the most distinct characters—is not often available for determination; but under the microscope the cordate leaves with short nerve and long narrow acumen are quite distinct from those of all our mosses except *Hypnum molluscum*, which, moreover, it often simulates in habit; the angular cells of that species are, however, almost always clearly defined; the median ones usually shorter, often much wider, and the leaves themselves almost always falcato-secund with more flexuose points and less distinct serratures; in the present plant the leaves though occasionally secund are rarely falcately curved. In mountains streams it often becomes much elongated, with long simple branches, hardly pinnate, somewhat like the similar forms of *Hypnum ochraceum*. It fruits perhaps more frequently in the valleys of N. Wales than elsewhere, and the capsules are sometimes produced in abundance.

Owing, doubtless, in part to their somewhat amplexicaul insertion, the leaves are with some difficulty detached from the stems, which are consequently usually found leafy, and not denuded, to the very base. Some of the forms it assumes are very beautiful from their regularly plumose branching and bright, golden foliage.

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110. **EURHYNCHIUM** B. & S. (emend. Milde).

(Eurhynchium *B. & S.*, Rhynchostegium *B. & S.*, and Isothecium *Brid.*, Schp. Syn., &c.).

Mosses of varying habit, as in Brachythecium. Leaves more or less erect and imbricated, *not distinctly falcato-secund, rarely complanate*, single-nerved, or rarely almost nerveless. Cells linear, rhomboid, or hexagonal-rhomboid, *rarely less than five times as long as broad*. Seta smooth or papillose. Lid *long-beaked*, rarely rostellate. Peristome perfect.

This genus as here understood includes Rhynchostegium B. & S., which is not marked by any satisfactory characters. I have also included Isothecium, which differs in no very important characters. Eurhynchium differs from Brachythecium mainly in the rostrate lid, from Plagiothecium in the leaves rarely com-

planate, the long-beaked lid, the nerve single and usually long, though some species are somwhat intermediate in their generic characters; from Amblystegium in the longer, narrower areolation, the rostrate lid and frequently rough seta.

DERIV.—εὖ-(eu) well, finely, ῥυγχιον (rhynchion) beak. Alluding to the long beak of the lid.

1 { All the leaves narrow, lanceolate; plant very small and slender.....2
  { Ls., at least the stem-ls., ovate-lanceolate, ovate, or oblong.....3

2 { Seta smooth (rarely rough); ls. almost setaceous, silky.....*10. tenellum*
  { Seta rough; ls. with less fine acumen.....4

3 { Ls. broadly nerved almost to apex, dark green.....*9. Teesdalei*
  { Nerve slender, ceasing about ½ or ¾ up leaf.....5

4 { Dioicous; cells rather short, 4-6 times as long as wide.....*7. pumilum*
  { Autoicous; cells longer.....*8. curvisetum*

5 { Stem pinnate or more or less bipinnate, with paraphyllia; stem-ls. very decurrent, triangular, with long fine acumen (seta rough) *5. praelongum*
  { Stem not bipinnate; stem-ls. less or not decurrent.....6

6 { Stem-leaves concave, abruptly piliferous.....7
  { Stem-leaves acute or acuminate, not suddenly piliferous.....8

7 { Stem usually pinnate, elongate; not alpine.....*2. piliferum*
  { Stem irregularly branched; alpine plant.....*1. cirrosum*

8 { Capsule almost erect and symmetrical.....*12. myurum*
  { Capsule curved, cernuous (sub-erect in *E. mysouroides*).....9

9 { Branch-ls. (or some of them) sub-obtuse, closely imbricate when dry (seta smooth).....10
  { All the leaves acute.....12

10 { Ls. more or less elliptic, wide at apex.....*18. murale*
   { Ls. more or less ovate or lanceolate, narrow towards apex.....11

11 { Branches curved; cells short.....*13. circinatum*
   { Branches short, not or scarcely curved; cells long.....*14. strigosum*

12 { Stem-ls. cordate-triangular, with more or less distinct angular cells (seta smooth).....13
   { Stem-leaves ovate, not cordate, angular cells not very distinct.....16

13 { Ls. smooth, even when dry; capsule sub-erect.....*11. myosuroides*
   { Ls. striate, especially when dry; capsule cernuous.....14

14 { Branching irregular, leaves almost squarrose.....15
   { Branching sub-dendroid; slender; ls. erecto-patent, small *16. striatulum*

15 { Robust, in lax tufts; leaves tapering to a wide point, rigid...*15. striatum*
   { In dense tufts; ls. longly and finely acuminate, flexuose...*15*. meridionale*

16 { Seta rough; synoicous or dioicous.....17
   { Seta smooth; autoicous.....20

17 { Leaves closely imbricated.....18
   { Leaves loose, often sub-complanate, not closely imbricated.....19

18 { Leaves striate, scarcely concave.....*6*. abbreviatum*
   { Leaves not striate, very concave; nerve very stout at base *3. crassinervium*

19 { Synoicous; plant deep green, rather robust.....*4. speciosum*
   { Dioicous; smaller, usually dull or yellowish green.....*6. Swartzii*

20 { Ls. firm ; nerve strong, nearly reaching apex ; more or less aquatic *17. rusciforme*
Nerve thin, about ⅔ length of leaf ; terrestrial 21

21 { Ls. roundish-ovate, much twisted when dry ; cells 12 μ wide *21. rotundifolium*
Ls. narrower, scarcely twisted ; cells 5 or 6 μ wide.....22

22 { Ls. very concave, more or less imbricate, shortly pointed.....*18. murale*
Ls. scarcely concave, acuminate.....23

23 { Stem short, rooting ; on walls, trees, etc.....*19. confertum*
Stem often longish, rooting at base only ; on the ground *20. megapolitanum*

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* Seta rough.

1. Eurhynchium cirrosum Jur. (*Hypnum cirrosum* Schwaeg., Braithw. Br. M. Fl. ; *Brachythecium cirrosum* Schp., Syn.) (Tab. LIII. M.).

In loose, straggling patches ; stems short, irregularly branched, prostrate ; branches *robust, tumid, julaceous, sub-obtuse*, longer or shorter, straight, erect or depressed ; bright or golden green, *glossy*, brown below. Leaves *closely imbricated, very concave, cochleariform*, widely ovate-oblong, large, 1 line long or more, rounded at apex and *suddenly contracted into a very long hair-like point*, decurrent at base, plicate when dry, entire or slightly denticulate above ; nerve slender, hardly reaching beyond the middle, sometimes forked ; cells *longly linear-rhomboid*, acute or slightly obtuse, sometimes somewhat vermicular, at angles wide, sub-quadrate. Seta short, rough ; capsule dark brown, ovate, gibbous ; lid acutely rostellate.

HAB. Alpine rocks, very rare and sterile ; only on Ben Lawers.

A very distinct plant, resembling no others of the British mosses except perhaps *E. piliferum*, which differs in the more slender branches with the leaves much less densely imbricated, and the areolation laxer, becoming especially wide at the base. It is by many authors considered a variety of the continental *E. Tommasinii* Sendt. (*E. Vaucheri* B. & S.), and its affinity to that species is so undoubtedly close that I have thought it better to place it in this genus than in Brachythecium, with which it is usually united, at least in our British works. There appears indeed to be absolutely no difference in the leaves between this plant and some unquestioned forms of *E. Tommasinii* beyond the greater concavity of those of the former ; the areolation appears to be often identical in both, although in this the cells are more frequently somewhat vermicular and obtuse at the ends than in that ; and although the leaves in the present plant are characteristically much more suddenly piliferous still some leaves may be found with less abruptly contracted points, while on *E. Tommasinii* leaves frequently occur exhibiting this character exactly, though less concave. On the whole, although the habit is so different, it appears most probable that it will ultimately have to be united with the species in question, but I have here retained the old name and contented myself with removing it from Brachythecium and placing it in the present genus. The fruit is extremely rare, but has recently been found in a few localities on the continent.

2. Eurhynchium piliferum B. & S. (*Hypnum piliferum* Schreb., Braithw. Br. M. Fl.) (Tab. LIV. B.).

In large, loose straggling patches; stems *elongated*, not radiculose, prostrate and creeping, 3–6 inches long, robust, more or less regularly pinnate; *pale, shining green, especially pale and whitish at the tips of the stems and branches*. Branches *complanate*, spreading and recurved, attenuated. Stem-leaves widely ovate-oblong, *concave*, but not cochleariform as in the last, decurrent, *rounded at summit and abruptly and longly hair-pointed;* at the ends of the stems closely imbricated, forming terete, cuspidate tips with the hair-points spreading and flexuose; margin plane or inflexed, sub-entire or slightly denticulate throughout; lightly striate only when dry; nerve broad at base; slender above, and vanishing about the middle or at three-fourths of the length of the leaf; areolation rather large, and pellucid, *widely linear-rhomboid*, thin-walled, tapering at ends, 10–15 times as long as wide, at base shorter and wider, rather lax; at decurrent angles large, oval-rectangular, well-defined. Branch-leaves smaller, narrower, less abruptly and less longly pointed. Seta about 1 inch long. Capsule widely elliptical, large, about 1 line long without the lid, curved; conical with a subulate beak almost as long as the capsule. Dioicous.

HAB. In woods, on grassy banks, etc., common. Fr. very rare, winter.

A fine species, in some of its more densely branched forms somewhat resembling *Brachythecium salebrosum* and others of that genus; but a glance at the stem-leaves, abruptly piliferous, will at once identify it. It is a more slender plant with more distant leaves than the last, the only British moss with which it could at all easily be confused; and the habitats of the two species are quite distinct. It is more like the continental species *E. Tommasinii* Sendt. (*E. Vaucheri* B. & S.), which however differs in the stems being fasciculate-branched, not pinnate, with numerous slender stolons, and in the more shortly rostrate lid.

E. piliferum is usually recognisable at sight by the slender, pinnate branches very pale and shining at the tips.

3. Eurhynchium crassinervium B. & S. (*Hypnum crassinervium* Tayl., Braithw. Br. M. Fl.) (Tab. LIV. A.).

In dense tufts, the stems creeping with sub-erect, short, irregularly branched divisions; branches *close, sub-equal*, straight or slightly curved, *pointing in one direction*, somewhat cylindrical, shortly acute; forming bright green, rather glossy, low tufts. Leaves sub-equal, the stem-leaves rather wider; branch-leaves *closely set*, erecto-patent, when dry more erect and imbricated, widely or narrowly *ovate-oblong, rapidly contracted to a very short acute acumen, very concave*, irregularly plicate when dry, denticulate, especially above; margin narrowly recurved at base; nerve *very stout, especially in the lower half*, reaching about $\frac{3}{4}$ length

of leaf, sometimes projecting from the back of the leaf at its tip in a minute point; cells *rather short and wide*, the median narrowly rhomboid, tapering at the ends, *6–10 times as long as broad*, the walls firm and somewhat incrassate; gradually becoming shorter and wider upwards, at apex shortly elliptical-rhomboid; at base laxer, wide, sub-rectangular, especially at angles, opaque and chlorophyllose. Capsule oval-oblong, gibbous at back, with a distinct neck; lid subulate-rostrate, as long as capsule. Dioicous.

Hab. Stony ground in shady places, woods, etc.; not common. Fruit rare, autumn.

E. crassinervium is not a very variable species, except in degree of robustness; it sometimes occurs with the branches exceedingly slender and much attenuated (var. *tenue* Braithw.). On the other hand it occasionally becomes very robust, with turgid, obtuse branches; this is the var. *turgescens* Mol., which I have gathered in one or two localities in Scotland and the North of England. *E. crassinervium* has a somewhat characteristic habit, rather like that of *Brachythecium caespitosum* on a more robust scale, the branches being somewhat tumid and cylindrical with the leaves regularly imbricated, but hardly terete or julaceous, as the leaves are not appressed nor their points incurved. They may be at once recognised by the very stout nerve, which is of almost uniform thickness for about half its length, when it either forks, but rarely, or more frequently takes a slight bend and becomes much thinner, as though it had forked and one branch had been suppressed. The leaves are very concave, with a rather wide, reflexed and flattened edge all round, like the edge of a dish or platter. It appears to fruit less frequently on the continent than in Britain. There are several other species with which this might be confused in the field, but under the microscope the characteristic leaf form and structure, best understood perhaps by a reference to the figure, will as a rule at once identify it.

E. velutinoides B. & S., a continental species, is somewhat intermediate between this and *Brachythecium populeum*; it has narrower leaves and much longer nerve than the present species, and is best known from the latter by the rougher seta, dioicous inflorescence and rostrate lid. It is recorded from Sussex in the Bry. Eur., but without doubt erroneously. A specimen in Herb. Mus. Brit. collected by Davies at Petworth, Sussex, so named, belongs to *E. crassinervium*; and the plant recorded as *E. Vaucheri* in Smith's Flora of Sussex probably refers to the same specimen.

4. Eurhynchium speciosum Schp. (*Hypnum speciosum* Brid., Braithw. Br. M. Fl.) (Tab. LIV. C.).

Stems creeping, *elongated*, irregularly divided, the divisions also prostrate, interruptedly pinnate, with rather short, erect branches; forming straggling patches of a *deep, vivid green*. Leaves *large*, ¾–1 line long, those of the stem distant, *widely deltoid-ovate, acuminate*, somewhat spreading; of the branches *sub-complanate, rather distant, divergent*, narrow-ovate, shortly acuminate or acute, strongly denticulate all round, somewhat concave, not plicate, margin almost plane; nerve strong, ¾ the length of the leaf or more, *frequently reaching to within a short distance of the apex*; areolation linear-rhomboid, moderately wide,

and thin-walled, but *opaque*, so that the leaves are not pellucid, 6–12 times as long as wide ; at base laxer and sub-rectangular, but not or hardly distinct at angles. Seta about 1 inch long ; capsule large, short, turgidly oval, dark brown ; lid longly rostrate. *Synoicous*, or partly autoicous.

HAB. Stones and tree roots near water, rare. Fr. winter.

A fine species, with large, rather distant leaves of a peculiarly bright shining green ; known also by the opaque tissue and long nerve, as well as by the habit, the rough seta and the synoicous inflorescence. The stems are usually more or less stoloniform in the intervals between the groups of branches. In its more slender forms it comes extremely near dark green, robust forms of *E. Swartzii*. As a rule it may be known by the more opaque, larger leaves, and the narrower cells, but occasionally, though rarely, forms occur which in the absence of inflorescence may almost defy determination.

5. Eurhynchium praelongum Hobkirk, Synopsis of Brit. Mosses, 2nd Ed. 1884 (*Hypnum praelongum* L., Braithw. Br. M. Fl. ; *Eurhynchium Stokesii* B. & S., Schp. Syn. et mult. auct.) (Tab. LIV. D.).

Stems (in the type) *slender*, prostrate, *elongated* (2–5 inches), divided ; at intervals *rather regularly pinnate, with slender, somewhat attenuated*, often curved, not very crowded, sub-complanate branches ; forming low, somewhat straggling masses of a bright or dull green, frequently yellowish. Stem-leaves distant or more rarely crowded, *widely cordate-triangular or widely ovate-cordate, rapidly or even abrupily and longly acuminate in a long, often almost filiform squarrose acumen ;* at base wide, excavate, *strongly decurrent ;* margin plane, regularly and distinctly denticulate ; nerve slender, reaching above half-way and usually into the acumen ; cells linear, slightly vermicular, tapering but obtuse, *10–18 times as long as wide*, pellucid ; towards base wider and shorter, lax, at angles large, sub-rectangular, but not forming clearly defined auricles. Paraphyllia occasionally but not always present. Branch-leaves *much narrower, widely or even narrowly lanceolate, gradually acuminate, very acute, somewhat erect when dry*, more spreading when moist, *not complanate*, moderately soft in texture and often twisted when dry, not plicate, *hardly glossy*. Perichaetial bracts squarrose, very longly acuminate. Seta rather long, often one inch. Capsule turgidly ovate, narrower when ripe and empty, horizontal, abruptly passing into the seta at base, rather large, brown or olive green, *blotched with black ;* lid subulate-rostrate, usually decurved, almost as long as the capsule. *Dioicous*.

Var. *β. Stokesii* Brid. (*Hypnum Stokesii* Turn. ; *H. praelongum* var. *Stokesii* Brid., Wils. Bry. Brit.). Stems more robust and rigid, *more densely and regularly pinnate and bipinnate, deep* green ; paraphyllia more numerous ; stem-leaves more crowded ; branch-leaves *wider at the base*, but longly acuminate, crowded.

HAB. Hedgerows, grassy places, stumps of trees, etc., most abundant on clayey soil; very common. The var. β less common, most frequent in mountainous woods. Fr. winter.

There has been and apparently still exists considerable confusion as to this and the following species, partly arising from a doubt as to the original plant intended by Linnaeus, partly from divergent views as to the value and affinities of the different forms. Wilson (*Bry. Brit.*) gives a very clear account of the difference between the plants, and the view there taken is entirely in harmony with my own observations upon a large number of specimens. The authors of the Bry. Eur. described under the name of *E. praelongum* the plant known by us and described below as *E. Swartzii*, under the belief that it was the plant known to Linnaeus and Dillenius as *Hypnum praelongum*. This however Lindberg has shown to be an error; *H. praelongum* L. is the plant now under consideration, and it has been always known under that specific name among British bryologists.

Continental authors also fail to draw a distinction between the type of *H. praelongum* L. as here described, and the var. *Stokesii*, which although connected with the type by intermediate forms is a marked enough variety; the descriptions of *E. Stokesii* B. & S. indeed usually apply to the variety, and are not at all applicable to the slender, trailing, loosely pinnate plant common with us in the lowlands, which would appear to be scarcely known on the continent.

E. praelongum and its var. *Stokesii* differ from *E. Swartzii* in the more elongated habit, the more regularly pinnate stems with very slender and usually attenuated branches; the plants usually of a brighter green, not so generally yellowish, the leaves of softer texture and hardly glossy when dry; and especially in the wide difference between the stem and branch-leaves; the former being widely cordate, often distinctly triangular, with long and narrow squarrose acumen, those of the branches much narrower, often quite narrowly lanceolate, much smaller, very acute, not complanate, rendered more appressed and imbricate, and often somewhat twisted, in drying. In *E. Swartzii* (the type as described below) the stems are usually less elongated, hardly or very indistinctly pinnate, the colour usually pale yellowish, rarely dark green, the branches (with the leaves) stouter and more obtuse, the leaves very frequently sub-complanate, the leaves of stems and branches much more alike, those of the stem being widely ovate but not triangular and hardly cordate, less strongly decurrent, more shortly and gradually acuminate or only acute; branch-leaves sub-similar, much larger and wider than in *E. praelongum*, widely ovate, shortly and broadly pointed, the cells shorter and wider.

The squarrose stem-leaves of peculiar form, taken in conjunction with the narrow branch-leaves and the general habit of the plant make *E. praelongum* usually an easy plant to recognise, though somewhat liable to variation. In some of its forms it looks much like *Amblystegium filicinum*, but the similarity disappears on a nearer view.

6. Eurhynchium Swartzii Hobkirk, op. cit. (*Hypnum Swartzii* Turn., Braithw. Br. M. Fl.; *Eurhynchium praelongum* B. & S., Schp. Syn. et mult. auct.; *H. anomalum* Stirt. in Ann. Scot. Nat. Hist. xv, 112) (Tab. LIV. E.).

In pale yellowish tufts, sometimes dark green; stems prostrate, with *irregular or indistinctly pinnate branches*, which are usually spreading and somewhat distant, not erect and crowded in the type, *obtuse*, *short*, nearly straight. Stem-leaves *widely ovate*, slightly decurrent, gradually shortly or longly acuminate,

squarrose ; branch-leaves sub-similar, but *never longly acuminate, usually shortly acute or even bluntly pointed*, widely ovate, all somewhat distant, spreading, *usually sub-complanate, hardly altered in form or direction when dry, glossy*, sub-scariose, not or scarcely striate, regularly denticulate nearly all round ; nerve rather thick, reaching to $\frac{3}{4}$ of the leaf, usually ceasing abruptly and often projecting in a minute point at the back ; cells at basal angles wide, rectangular, above *short, 6–10 times as long as broad, 6–7 μ wide*, obtusely linear, at apex *much shorter and wider*, elliptic-rhomboid ; in the branch-leaves shorter, 4–6 times as long as broad. Seta and capsule shorter than in the last. Dioicous.

Var. *β. rigidum* Boul. Robust, *rigid*, branches *crowded, more or less erect, obtuse ;* leaves *imbricated all round the branches, not complanate*, so that the branches are cylindrical ; shortly pointed, concave ; nerve stout ; cells short.

HAB. In similar localities with the last, but usually in more open situations, most frequent in calcareous districts. The var. *β* rare, I. of Wight ; Yorkshire ; Northumberland ; Sutherland. Fr. rare, winter.

The differences between this and the last species are pointed out under that plant ; to this it may be added that the fruit appears to be rarer in the present species than in that.

The name *atrovirens* has been sometimes applied to the whole species, and has perhaps led to misconception ; Wilson indeed, who certainly understood it, speaks of the deep green colour, but I cannot but think this is exceptional ; I have only rarely found it of a deep green ; it is almost always more or less yellow. The dark green form that sometimes occurs is often accompanied by some difference of habit, being somewhat more robust and rigid, more glossy, with the leaves rather wider, but these characters are inconstant. It is the var. *atrovirens* B. & S. (*H. atrovirens* Sw.).

Dr. Grout has conclusively shown (Bull. of Torrey Bot. Club, xxv, 234) that *H. hians* Hedw. cannot be separated from *E. Swartzii*. It should be borne in mind that the size of the cells, the decurrence and serration of the leaves, as well as their width and degree of acumination, are all characters eminently variable within the admitted limits of *E. Swartzii*, and therefore slight differences based on these characters must not be held as constituting specific distinction between plants so closely allied.

The var. *rigidum* is a well-marked one, in the closer, imbricated leaves, and densely branched habit approaching *E. abbreviatum*, but quite distinct in the shorter, scarcely striate, not acuminate leaves, with short, not narrow cells. On account of these structural details it is perhaps best to subordinate it to the present species, not to *E. abbreviatum*, which it resembles more closely in habit.

* **Eurhynchium abbreviatum** Schp. (*E. praelongum* var. *abbreviatum* B. & S. ; *Hypnum Schleicheri* Hedw. fil., Braithw. Br. M. Fl.) (Tab. LIV. F.).

Allied to *E. Swartzii ;* in wide *dense* tufts ; branches *densely crowded, erect or ascending*, straight or curved, *short, robust, obtuse ;* leaves *crowded, imbricated all round, not complanate*, rather large, ovate-triangular, gradually tapering, somewhat

concave; *plicato-striate;* apex *markedly half-twisted;* cells *very narrow, 3–5 μ wide,* and 8–12 times as long. Seta *short,* ½-inch long; capsule shortly and widely oval.

HAB. Shady woods, rare; perhaps rather a southern species, but found in Sutherland. Fr. autumn to spring.

Very different in habit from the last, being denser, less straggling, more robust, with larger, much closer, striated leaves, and resembling a small state of *E. striatum*, or *E. striatulum*; from the latter it is indeed somewhat difficult to distinguish in the field, but it wants the very distinct, opaque basal cells which are characteristic of that plant, and the seta is rough.

The half-twisted apex is a characteristic feature; other species of this and allied genera sometimes show an approach, but only sporadically, to this character, which is very marked and constant in a large number of exotic pleurocarpous mosses.

The narrow cells and the striate leaves at once distinguish it from *E. Swartzii* and its var. *rigidum*, even when, as occasionally happens, the habit is more straggling and less distinct than usual.

7. Eurhynchium pumilum Schp. (*Hypnum pumilum* Wils.; *H. pallidirostre* Braun, Braithw. Br. M. Fl.) (Tab. LIV. G.).

Stems *extremely slender*, hardly an inch long, with irregular, *filiform* branches; in close, very low, soft tufts of a bright deep green. Leaves *very small*, about ¼ line long, distant, spreading, both when moist and when dry, often sub-complanate, *ovate-lanceolate, shortly acuminate*, at base little narrowed, not excavate and hardly decurrent; denticulate above; when dry shrinking, not or hardly glossy; nerve *not strong, reaching just above half-way;* cells *short, pellucid, hexagonal-rhomboid, 4–8 times as long as broad*, wider and rectangular at base, angular not distinct. Seta short, ¼–⅓ inch, capsule very small, shortly and widely oval, lid moderately long. *Dioicous.*

HAB. Stony ground, rocks, etc., in shady places; not common. Fruit rare, winter.

A very delicate plant, resembling compact forms of *Amblystegium serpens*, but usually in neater, smoother tufts, with the leaves much more shortly acuminate and more oval, more denticulate above, and quite distinct in the fruit. From *E. Teesdalei* it differs in the short rather faint nerve, and shorter, wider, pellucid cells; from *E. curvisetum* in the wider leaves and shorter more pellucid cells; from both in the dioicous inflorescence. The leaves are very frequently sub-complanate; when this is the case the plant in its more slender forms bears more resemblance to *Heterocladium heteropterum*, but the leaf structure is quite distinct.

8. Eurhynchium curvisetum Husn. (*Hypnum curvisetum* Brid., Braithw. Br. M. Fl.; *Rhynchostegium curvisetum* Schp., Syn.) (Tab. LIV. H.).

In small cushions, or wider patches, dull green, very short and slender, resembling *E. pumilum* and *E. Teesdalei;* branches

numerous, pale and cuspidate at the tips; leaves very small, *lanceolate, gradually acuminate to an acute or somewhat obtuse point;* faintly denticulate above; nerve *slender, reaching about half-way;* cells small, *linear-fusiform, 6–10 times as long as wide, rather opaque*, thin-walled, laxer and sub-rectangular at base, angular not distinct. Seta short, often curved; capsule very small, oblong with a distinct neck, lid longly subulate. *Autoicous.*

HAB. Rocks and stones near streams; very rare; chiefly in the south of England; Yorkshire. Fr. winter.

This species was for long confused with *E. Teesdalei*, but is quite distinct in its shorter nerve, and usually also in the more acuminate leaves, the rather larger cells with thinner walls, and the more distinct neck of the capsule; it usually also forms small isolated cushions, but sometimes grows, like *E. Teesdalei*, in wider patches; nor are the above secondary characters quite constant. Still it seems on the whole sufficiently distinct. From *E. pumilum* it differs in the narrower, lanceolate leaves, the longer cells, and the autoicous inflorescence; it may be usually found in good fruit in the winter months, whereas the fruit of *E. pumilum* is rare.

The var. *scabrellum* of *E. tenellum* might be easily confused with this species, but a careful examination will show that the leaves in that plant are always more longly and finely acuminate, almost setaceous, with a somewhat longer nerve and distinctly longer cells; the seta too is longer and the capsule rather larger.

E. curvisetum appears to be a rarer, and more southern species than *E. Teesdalei*.

The nerve in the Yorkshire plant is extremely faint and short.

9. Eurhynchium Teesdalei Schp. (*Hypnum Teesdalei* Sm., Braithw. Br. M. Fl.) (Tab. LIV. I.).

Very near the last species, but always in *wide, irregular patches*, frequently very dark green; the leaves *less narrowly acuminate*, often shortly or somewhat bluntly pointed; the nerve *stout, reaching to near the apex*, but somewhat variable; cells rather shorter, 5–8 times as long as broad, the walls distinctly incrassate; capsule rather shorter and wider, without a distinct neck; lid large, with a rather shorter beak. *Autoicous.*

HAB. In similar localities to the last, rare. Fr. winter.

The longer, strong nerve is the distinguishing character of this species, and the more broadly-pointed leaves and somewhat firmer areolation, besides the differences in the form of the fruit, must be taken into account. I find a plant however in Northamptonshire, growing in wide patches, which from its short nerve must be referred to *E. curvisetum*, but in the areolation and form of capsule also comes near *E. Teesdalei*, and I have other plants of this species with the nerve rather weak; and I am obliged to conclude that some of the characters held to distinguish the two are not always safely to be relied on.

* * Seta smooth.

10. Eurhynchium tenellum Milde (*Hypnum tenellum* Dicks.; *Rhynchostegium tenellum* B. & S., Schp. Syn.; *H. algirianum* Brid., Braithw. Br. M. Fl.) (Tab. LIV. J.).

In *very low*, yellowish, *very soft and silky tufts*, not half an inch high; stems densely intricate, about an inch long, prostrate, with numerous, erect or curved *very short branches*. Leaves erecto-patent, rarely sub-secund, not erect nor appressed when dry, *shining and silky*, about $\frac{1}{2}$-line long, *very narrow, linear-lanceolate, gradually tapering to a long attenuated point*, margin plane, *almost entire;* nerve distinct, *reaching high in the acumen* (rarely ceasing just above the middle); cells *extremely narrow*, linear-fusiform, 10–15 times as long as broad, at extreme base short, lax, sub-rectangular, *not distinct at angles*. Seta about $\frac{1}{2}$-inch long; capsule small, oval, somewhat variable in form and direction; lid longly rostrate. *Autoicous*.

Var. *β. scabrellum* Dixon, Handb. Ed. I. (*H. scabrellum* Mitt. *ined.*; *H. litoreum* De Not., Braithw. Br. M. Fl.). Leaves somewhat shorter, *less finely setaceous*, nerve usually *rather shorter*. Seta *more or less scabrous*. Growing usually *on wood or stones*.

Hab. Rocks and stones, most frequently in calcareous districts. Frequent. The var. *β* on wood and trunks of trees on calcareous soil, sometimes on stones; near Uxbridge (*Benbow*); near Lewes (*Nicholson*); Hurstpierpoint (*Mitten*); etc. Fr. spring.

A very distinct species, easily recognised by its low, silky tufts and extremely narrow, tapering, entire leaves. The seta is rather longer and the fruit rather more conspicuous than in the three preceding species. *E. curvisetum* is the only one which could be taken for it, having narrower, more tapering leaves than the other two, and the inflorescence autoicous; but the smooth seta and the still narrower, longer, entire, silky leaves identify the present plant, at least in its typical and ordinary form, without difficulty.

The var. *scabrellum* is a very remarkable and highly interesting form, demonstrating as it does the slight importance to be placed on the smoothness or otherwise of the seta as a systematic character for separating genera or groups of species (though as an artificial distinction it may often be very useful). It may be mentioned that Dr. Grout has described a var. *scabrisetum* of *E. strigosum*. I have received numerous specimens of the var. *scabrellum* from Mr. Nicholson and from Mr. Benbow, which all show the same characteristics and indicate that, in the districts in which it occurs, the form is widely distributed and even abundant; and the same is the case with the Hurstpierpoint plant. The latter was found by Mitten, and considered by him a distinct species, and has been distributed, I believe, as *H. scabrellum* Mitt. *ined.* I have ventured, therefore, to make use of that name, although I am unable to consider the plant specifically distinct from *E. tenellum*. The fact that the seta is sometimes nearly smooth, and at others, indeed, entirely so, appears to me to point strongly towards the varietal nature of the condition, and I can find no other constant character to separate it. It is identical with *H. litoreum* De Not., under which Braithwaite describes it, giving certain slight distinguishing characters apart from the rough seta, some of which I cannot verify on my specimens (*e.g.*, the relative length of the perichaetial bracts in this and *E. tenellum*), and the others (length of leaf and nerve) in my experience are very unreliable.

The setae show great variability as to roughness, some being as scabrous as in *E. curvisetum* and the allied species, while others on the same tufts may be found practically smooth, intermediate states, however, being the most frequent. As a rule, but not invariably, the tufts are much laxer, less silky, of a deeper green, and with shorter leaves than is usual in *E. tenellum*; indeed, agreeing closely with the form of the species described by Schimper (*Syn. Ed. II.*) as frequently occurring in the northern parts of Central Europe. In this form the variety bears a very close resemblance to *E. curvisetum*; but in every specimen I have examined the leaves exhibit a finer, almost setaceous acumination, with longer nerve and longer, quite different cells from those of *E. curvisetum*; while some of the specimens show exactly the normal and very distinct, dense, silky habit characteristic of our present species. In our localities it is described as usually growing on wood, branches, etc., near the ground, but Mr. Nicholson informs me he also finds it on trunks of trees as much as five feet from the base, and it occurs also, though less commonly, on flints and bricks.

11. Eurhynchium myosuroides Schp. (*Hypnum myosuroides* L.; *Isothecium myosuroides* Brid., Braithw. Br. M. Fl; *I. subglaciale* Stirt. in Ann. Scot. Nat. Hist. ix, 179) (Tab. LIV. L.).

Primary stem stoloniform, creeping, secondary erect or ascending, *sub-dendroid*, 1–2 inches long, the branches being as a rule crowded at their summits, *usually curved and more or less pointing one way*, and somewhat complanate, *acute*, *attenuated*, or even flagelliform; forming pale or yellowish green, rather robust tufts, somewhat glossy. Leaves of the secondary stems *cordate-ovate or widely ovate-oblong*, from a wide often excavate base, *rather suddenly contracted to a short or rather long, fine acumen*, concave, *denticulate almost all round*, nerve reaching about half-way or more, often very faint or almost wanting; branch-leaves narrower, imbricated or homomallous, oblong-lanceolate, *more or less acuminate*, not plicate nor decurrent, nerved to above the middle. Cells linear, at times somewhat vermicular, 5–10 times as long as broad, obtuse, with the walls firm and somewhat incrassate, at apex rather shorter and wider, at basal angles *distinct, small, sub-rectangular, 2–3 times as long as wide, opaque, forming small, well-defined, opaque or orange auricles*. Perichaetial bracts *squarrose*, longly acuminate. Seta rather short, slender; capsule *orange-brown, thin-walled, slightly inclined, curved, small*; lid conical, acuminate, or shortly rostellate. Cilia moderately long, not appendiculate. *Dioicous*.

Var. *β. rivulare* Holt. Robust, rigid, often *orange-brown*; branches *frequently strongly curved*; leaves *shortly pointed to almost obtuse*, closely imbricated. Fruit rare, rather large.

Var. *γ. brachythecioides* Dixon, Journ. of Bot., 1902, p. 379 (*Isothecium interludens* Stirt. in Ann. Scot. Nat. Hist. ix, 178). *Very robust*, 3–5 inches long, primary stems scarcely stoloniform, secondary *irregularly branched, not dendroid*, branches straight, very rarely decurved; branch-leaves *resembling the stem-leaves, large*, with rather *abrupt, long, fine points*.

Hab. Rocks and stumps of trees, frequent, especially in sub-alpine districts. Var. β on boulders by mountain streams, not infrequent. Var. γ, Scotland; Ireland; rare. Fr. autumn and winter.

A very variable plant, sometimes being very robust, at others extremely slender with delicate, filiform branches. The seta is very persistent, and old capsules may usually be found in company with those of the present year.

This species most resembles *Eurhynchium myurum*, and some forms are difficult to distinguish in the barren state; but the yellowish colour of the present plant, the more attenuated branches, acuminate leaves more strongly denticulate, and the longer, not quadrate angular cells are usually sufficient to distinguish it; and, when fruiting, the squarrose-pointed perichaetial bracts and inclined, more arcuate capsules. With that exception it is not a difficult plant to recognise, at least with the microscope; the areolation, and especially the small obscure angular cells, being very different from that of almost all our pleurocarpous mosses with single-nerved, acute leaves. See however the note on *Brachythecium caespitosum*.

The var. *rivulare* is a very distinct and handsome plant; the colour, and the short, broadly pointed, closely imbricated leaves, rendering the branches almost julaceous, are very striking; it passes however into the type by a gradation of forms. It is very abundant by some of the Welsh mountain streams.

The var. *brachythecioides* is also very distinct, much more robust than the ordinary form, and quite without the typical dendroid habit; in branching it resembles a Brachythecium. The most striking feature is the form of the branch-leaves, which do not taper gradually to a rather wide point as in the other forms, but are somewhat abruptly fine-pointed like those of the stem. Dr. Stirton has it from several localities in the Scotch Highlands.

Other varieties are the var. *filescens* Ren., an extremely slender, attenuated form, united by Limpricht with other small forms under var. *cavernarum* Mol. Var. *tenuinerve* Kindb. has widely cordate stem-leaves with long setaceous points, and weak nerve; var. *debile* Braithw. is a slender variety with oblong-lanceolate, entire branch-leaves.

12. Eurhynchium myurum Dixon (*Hypnum myurum* Poll. *Isothecium viviparum* Lindb., Braithw. Br. M. Fl.; *Isothecium myurum* Brid., Handb. Ed. I.). (Tab. LIV. K.).

In large pale or yellowish green, rather rigid, glossy patches. Secondary stems erect or drooping, with numerous somewhat crowded branches *pointing in one direction, curved, usually terete when dry*, with the leaves imbricated, or longer, attenuated and sub-flagelliform, with laxer leaves. Leaves *concave, widely ovate-oblong*, acute or shortly or widely apiculate, rarely shortly piliform-acuminate; those of the branches smaller, less acuminate; margin plane or very slightly recurved at base, above involute, *at apex slightly denticulate;* nerve thin and narrow, rarely stout, sometimes slightly forked above, reaching to the middle of the leaf or slightly higher; cells of the greater part of the leaf narrow-linear, obtuse, vermicular, incrassate, about 6–10 times as long as broad; towards mid-base more elongated, above shorter, at apex wide and shortly-rhomboid; at basal angles wide, *rounded-quadrate or shortly oblong, 1–2 times as long as broad*, often yellowish, opaque, forming minute auricles; a few rows at margin above these short, sub-quadrate. Perichaetial bracts sheathing, acum-

inate, *erect, with the points only slightly divergent.* Seta smooth; capsule orange-brown, *erect*, elliptic-oblong or oblong, with a short neck; lid rostrate, straight or slightly curved; peristome small, cilia very short. Dioicous.

Var. *β. minus* Bagnall, *Notes on the Flora of Warwickshire*, p. 40 (*Isothecium myosuroides* var. *minus* Braithw., Br. M. Fl.). *Very slender*, leaves *very small*, acute; areolation *laxer*, with the walls less incrassate.

HAB. Trunks of trees; more rarely on rocks or earth. Common. The var. *β* in several localities in Warwickshire (*Bagnall*); Northamptonshire (*Dixon*). Fr. spring.

I have adopted what may be thought the somewhat bold course of uniting this species with Eurhynchium. The unsatisfactory plan of separating two so obviously allied plants as this and the last species is evident; a slight difference in the inclination of the capsule being practically the sole title to generic distinction. Nor do I think the sub-dendroid habit and form of capsule justify us in separating the whole group from Eurhynchium as an independent genus. *E. myurum*, although dicicous, is frequently found fruiting, and is therefore easily known from all its allies except *Eurhynchium myosuroides*. The latter plant bears a great resemblance to it, but is clearly distinct in its spreading, almost squarrose, perichaetial leaves; the capsule also is usually more inclined and curved, the branches more slender, attenuated and flagelliform, the stem-leaves as a rule wider and all the leaves much more acuminate; these last characters are however less constant. A more reliable character in the barren plant is probably the form of the angular cells, which in this are distinctly shorter, irregularly rounded or sub-quadrate; but even this character is at times somewhat ill defined. The marginal rows of sub-quadrate cells above the angular groups will often be a guide, and the leaves are as a rule more oblong, or even sub-obovate, as compared with those of the last species. Some forms are somewhat like *Brachythecium caespitosum*, but the leaves are less concave and the areolation is different. *Pterogonium gracile* differs in the more regularly terete branches with wider, more closely imbricated, two-nerved leaves.

A large form with obtuse, julaceous branches is known as the var. *robustum* B. & S., but I have seen no British forms approaching the very large plant that occurs on the continent. The var. *minus* described above appears also worthy of notice, differing as it does from the type not only in the small size, but in the distinctly laxer cells; the latter character is however variable. Braithwaite ranks it under the last species, but the habit and especially the basal areolation seem to place it here.

13. Eurhynchium circinatum B. & S. (*Hypnum circinatum* Brid., Braithw. Br. M. Fl.) (Tab. LIV. M.).

In smooth, dense tufts, *bright green*, often becoming yellowish when old. Primary stems creeping, stoloniform, secondary ascending, *curved*, about 1 inch long, with *numerous, crowded branches at their summits*, which are *strongly arcuate-decurved, very short*, slender and *cylindrical, or julaceous*. Leaves of the secondary stems *minute* ($\frac{1}{8}$–$\frac{1}{2}$ line), *widely ovate, shortly and widely, often obtusely acuminate*, lightly plicate when dry; of the branches narrower, oblong-lanceolate, *acute*, crowded,

erecto-patent when moist, *closely appressed and imbricated when dry*, rendering the branches terete and cylindrical, or with the leaf-points a little falcato-secund; margin *recurved at base*, coarsely denticulate at apex, more finely below; nerve *very strong and wide*, reaching nearly to apex. Areolation *very short*, median *elliptic-rhomboid, 3–4 times as long as broad*, the walls firm, somewhat incrassate; shorter at apex, at base and angles short, irregularly quadrate, rather opaque, covering a large area. Seta short. Capsule ovate-oblong, oblique; lid with a moderately long beak. Dioicous.

HAB. Rocks, principally calcareous; South of England, Wales and Ireland, rare. Fr. spring, not found in Britain.

Resembling in habit small forms of *Pterogonium gracile*, but more slender with shorter, more curved branches, and very different in the single-nerved leaves. From the next species it differs in the densely crowded, not shining leaves and strongly curled, more slender branches. From all the other species of the genus it differs in its short firm areolation; and indeed it is not likely, from its habit alone, to be confused with any other plant. The fruit is very rare, but is found in some abundance in certain localities in the South of Europe.

14. Eurhynchium strigosum B. & S. (*Hypnum strigosum* Hoffm., Braithw. Br. M. Fl.) (Tab. LIV. N.).

Allied to the last species; differs in the branches *less fasciculate*, more robust, more erect and *less curved*, the tufts more straggling and of a bright *shining green;* the branch-leaves less closely imbricated, *more spreading when dry, variously pointed or more usually obtuse;* margin *plane;* nerve rather thinner and often shorter; median cells *longer and much narrower, linear, or linear-rhomboid, 6–12 times as long as broad.* Dioicous.

Var. *β. diversifolium* Lindb. (*Eurh. diversifolium* B. & S., Schp. Syn.). More densely tufted, branches *erect, julaceous;* branch-leaves *closely imbricated, erect, not spreading when dry, obtuse*, denticulate throughout the greater part of the margin; seta and capsule shorter.

HAB. Stones, roots of trees, &c. Cornwall (*Tozer*), according to specimens in Herb. Hook. The var. *β*, Scotland (*Fergusson*). Fr. winter; not found in Britain.

Until recently the specimens in Hooker's Herbarium, mentioned above, formed the only record of this species, widely spread upon the continent, in our islands. It has since been found, however, by the Rev. J. Fergusson, in a single locality in Scotland, and I have a specimen gathered under his guidance by the Rev. H. G. Jameson. This undoubtedly belongs to the var. *diversifolium* as understood by Boulay and Husnot, though a comparison of their descriptions with that of *E. diversifolium* in Schimper (*Synopsis, Ed. II.*) would lead one to suppose that the latter author had a somewhat different conception of the variety from that which the later writers have in view;

at any rate Schimper lays stress on characters of which the latter take no account, while the principal characters which they describe are equally applied to a great extent, by Schimper, to the var. *imbricatum* of *E. strigosum*. In short, Boulay and Husnot make the var. *diversifolium* simply a more marked form of the var. *imbricatum* (var. *praecox* Wahl.), while Schimper evidently considered that it had other distinctive characters. Whether or not they are right, however, in applying Bruch and Schimper's name to it, their variety certainly rests on somewhat more satisfactory characters; but it must be pointed out that obtuse branch-leaves are by no means confined to this form. In several specimens from N. America I find them quite as obtuse on the more robust, straggling form with spreading, not erect nor julaceous branches having the leaves somewhat distant and widely spreading when dry; nor is the striation of the leaves, which is a character frequently occurring in this species, confined to one peculiar form, as Schimper's description would seem to imply. In fine, it is questionable whether the above varietal forms are capable of at all exact definition. Even among the markedly "julaceous" plants from Scotland I have found one stem with the loose habit and spreading, somewhat distant leaves of the type.

E. strigosum is closely allied to the last species, but is a much more variable plant; it may usually be known by the more or less obtuse branch-leaves from stunted forms of *E. praelongum* and other species, while from *E. circinatum* it is best distinguished by its straighter branches and longer, narrower median cells. It sometimes occurs in straggling patches of a vivid shining green with the leaves very loosely set and spreading even when dry, but the var. *diversifolium* is smaller, with cylindrical, straight, or curved branches, the leaves much more crowded and imbricated, and then at times it very closely resembles the preceding species.

15. Eurhynchium striatum B. & S. (*Hypnum striatum* Schreb., Braithw. Br. M. Fl.) (Tab. LIV. O.).

Robust, in large masses, deep green or yellowish, *glossy*; stems rigid, arched or procumbent, 3–6 inches long, divided, with numerous, more or less pinnate, erect or ascending branches, which are robust and obtuse, with crowded leaves, or more slender and attenuated, with the leaves more spreading. Leaves *rigid, large, ⅔–1 line long, usually much spreading both wet and dry*; sometimes erecto-patent and imbricated when dry, but *scarcely erect or appressed, deeply striate with straight plicae* when moist and especially when dry, glossy, *widely cordate-triangular, gradually tapering to an acute but not attenuated point*; branch-leaves narrower, triangular, more longly but widely acuminate; all, at the base, from a narrow, slightly decurrent insertion, widely cordate and auriculate, *sharply serrate all round*, margin slightly recurved at the base only, nerve rather strong, reaching about ⅔ the length of the leaf; areolation linear, sub-vermicular, 8–15 times as long as wide, with firm walls, obtuse; rather shorter at apex, at mid-base scarcely altered; cells at angles *wide, oval-rectangular, few, rather large, more or less pellucid, forming small, not very distinct auricles*. Seta *long*, 1–1½ inches, stout; capsule *large*, chestnut brown, oblong-cylindrical, arcuate; lid longly subulate-rostrate; annulus *broad*, of 3 rows of cells. Dioicous, or occasionally with the male flowers attached by radicles to the fertile plant.

HAB. On the ground, rocks, etc., in woods. Common. Fr. late autumn.

E. striatum is a very distinct species ; the triangular leaves, strongly and regularly plicate when dry, and very rigid and regularly imbricated all round the branches, give it a marked appearance of its own. It is, perhaps, most like *Hylocomium brevirostre* in habit, but that plant will at once be recognised by the numerous paraphyllia and the abrupt, fine acumen of the leaf ; in the present plant the point is always wide, often so much so that to the eye the leaf appears obtuse. It also somewhat resembles robust forms of *Brachythecium rutabulum*, but the leaves are, on examination, of a quite different shape, strongly and regularly striate, and the areolation, smooth seta, and longly rostrate lid are of course conclusive. The differences between this and the following species and subspecies are given below.

*** Eurhynchium meridionale** De Not. (*Hypnum meridionale* Schp., Braithw. Br. M. Fl.) (Tab. LV. A.).

Smaller, in *dense tufts*, stems prostrate, branches *short, often erect and crowded*, not attenuated ; bright or yellowish green, glossy. Leaves *very widely spreading*, often almost at right angles to the stem, *flexuose or undulate when dry, more longly and finely acuminate*. Cells extremely narrow, the angular very numerous, smaller.

HAB. Limestone walls at Wells, Somerset, 1886 (*Binstead*). Portland Isle, Dorset. Fr. winter.

I admitted this plant originally on the authority of Dr. Braithwaite. A specimen of the Wells plant which Mr. Binstead kindly sent me proved to be only a rather small form of *E. striatum* ; but this may perhaps not have been identical with the original plant. The status of the species as a British plant, however, has been recently set satisfactorily at rest. An undoubted specimen exists in the late W. West's herbarium, collected on the Isle of Portland by W. C. P. Medlicott, and the plant has since been re-found by Sherrin and others growing in some quantity about Portland.

E. meridionale is a distinctly southern and Miditerranean plant, reaching no further north in France, so far as I am aware, than the Landes south of Bordeaux. It is quite distinct in its habit and the long-pointed, spreading leaves, more undulated but less regularly striate when dry, from both *E. striatum* and *E. striatulum*.

16. Eurhynchium striatulum B. & S. (*Hypnum striatulum* Spruce, Braithw. Br. M. Fl.) (Tab. LV. B.).

Primary stem creeping, secondary divisions erect or ascending, *more or less dendroid*, the branches being somewhat fasciculate towards their summits, *more or less arcuate and pointing in the same direction, as in E. myosuroides ; much more slender than in the last species*, dark or olive green ; stems about two inches long. Leaves *cordate-triangular or cordate-ovate*, $\frac{1}{2}$–$\frac{2}{3}$ *line long*, more narrowly and usually more longly acuminate than in *E. striatum*, *less strongly and distinctly striate*, less spreading when dry, *often erect and closely imbricated ;* nerve, for the size of the leaf, stronger ; cells shorter and, proportionately, wider, 6–10 times

as long as wide, *all basal short, wide*, irregularly quadrate-elliptical, *small, opaque, forming distinct dark auricles reaching to the nerve*. Seta *short*, ½–¾ inch, capsule short, oval-oblong ; annulus *narrow*, of a single row of cells. Dioicous.

HAB. Shady rocks, etc., rare. Principally in the South of England. Fruit rare, winter.

Although allied to the last species, and in some respects much resembling it, this moss is not so difficult to separate from it as is, perhaps, usually supposed ; I have indeed seen no specimens which could not be separated with the lens alone, although I have frequently seen small forms of *E. striatum* labelled *E. striatulum*, indicating a general supposition that the two are much alike. The present plant is a far more slender moss, and smaller in all its parts, with the branching much like that of *E. mysuroides*, and indeed with much the habit of that species ; the leaves much smaller than those of *E. striatum*, more finely acuminate, more appressed when dry in general ; and frequently of a different form. Those of *E. striatum* are always markedly triangular, the sides, above the rounded, cordate base being almost straight to apex, while in the present species they are often, *though not always*, rounded above, so that the leaf then has a decidedly oval outline. The most marked and constant difference, however, is in the areolation, especially that of the base ; *E. striatum* and *E. meridionale* never showing the band of opaque, dot-like cells filling up the whole base of the leaf to the nerve, which is characteristic of the present plant ; and the upper cells in those are distinctly longer, and in proportion narrower. The leaves in this are also somewhat less glossy.

E. striatulum is indicated from the Scotch Highlands ; I have, however, seen no Scotch specimens ; it is distinctly a southern species, and its chief distribution is throughout the Mediterranean region of Europe.

17. Eurhynchium rusciforme Milde (*Hypnum rusciforme* Weis, Braithw. Br. M. Fl. ; *Rhynchostegium rusciforme* B. & S., Schp. Syn. ; *H. ruscifolium* Neck.) (Tab. LV. C.).

In large, robust tufts, bright or deep green, often blackish, especially at base, when dry *glossy with a bright metallic sheen*. Stems prostrate or pendulous, irregularly divided, often very long, 2–6 inches, irregularly branched ; branches few or numerous, erect and arched, or long, straight, and parallel with the stem ; short, robust and obtuse, or longer, more slender and often much attenuated ; rather rigid, or moderately soft. Leaves usually *large*, ½–1½ *lines long*, more or less concave, *very widely ovate, shortly and more or less widely pointed*, in some forms obtuse ; margin plane, *regularly denticulate all round ;* nerve *very thick at base*, reaching ¾ the length of the leaf. Cells *very long and narrow*, linear-vermicular, obtuse, incrassate, *10–20 times as long as wide*, chlorophyllose and usually somewhat opaque, shorter at apex ; at extreme base large, wide, elliptic, the walls *strongly incrassate and porose*, occupying all base of leaf, but reaching higher at margin than at middle, usually chlorophyllose and opaque. Seta rather short, about ½–inch in length, flexuose ; capsule horizontal, oval-oblong, rather large, lid with a long curved beak Autoicous.

Var. *β. alopecuroides* Brid. Aquatic; in dense *brown or blackish* mats; stems floating with *almost simple, slender, cylindrical or terete often attenuated divisions;* leaves *small,* concave, *often sub-obtuse, very closely imbricated, not spreading,* erect and frequently appressed when dry.

Var. *γ. atlanticum* Brid. Stems *robust,* denuded at base, divisions and branches curved to one side, *rigid; leaves secund, homomallous,* large.

Hab. Rocks and stones in and near streams; often submerged. Common. The var. *β* submerged, in mountainous streams; the var. *γ* in waterfalls; both varieties mostly sterile. Fr. autumn.

A very distinct species, though more easily recognised from its general habit and appearance than from easily defined structural characters. The leaves, although often slightly twisted when dry, are of firm texture, and vary little in general outline, nerve, and areolation, though very variable in size, direction, and degree of acuteness; it is a more robust plant than any of its allies, and its habit is constantly more or less aquatic. Many varieties, besides those mentioned above, are described, but these appear to be the best marked; the leaves vary much in direction, being sometimes spreading and squarrose, even when dry, sometimes closely imbricated, often very concave. The vars. *prolixum* and *inundatum* Brid. do not appear on the whole to be so well marked as the varieties described above, and as to the former at least it is very difficult to get an idea from the descriptions of what it really is. The var. *alopecuroides* is a very distinct form, often of a coppery brown, occurring in mountain streams, with the leaves small, rounded-ovate, often obtuse, concave, closely imbricated, so that the branches are almost julaceous, soft and slender; it is the same form which Wilson describes in the Bry. Brit. from Leixlip, Ireland. A comparison of Bridel's description and notes on the var. *alopecuroides* leaves no doubt that Wilson is right in referring it to this variety, and the name should be retained (in preference to var. *prolixum* Turn.) on account of its priority, as well as its appropriateness and avoidance of ambiguity. The variety is I think as marked as any described under this species. I have it from more than half-a-dozen different localities, from N. Wales to Sutherland, in nearly all maintaining its characters with a great degree of constancy.

The var. *atlanticum* is also a marked variety, with very robust curved branches, and large, strongly homomallous leaves.

18. Eurhynchium murale Milde (*Hypnum murale* Hedw. Braithw. Br. M. Fl.; *Rhynchostegium murale* B. & S., Schp. Syn.) (Tab. LV. D.).

Short, in low dense patches; stems divided, 1–2 inches long, prostrate; divisions irregularly pinnate, with *short,* sub-erect, straight or slightly curved, *obtuse or sub-acute but not attenuated* branches, somewhat rigid, *often sub-julaceous; glossy green,* often becoming reddish. Leaves more or less crowded, erecto-patent, when dry somewhat divergent or closely imbricated, sometimes sub-secund, *very concave,* sometimes slightly plicate when dry, $\frac{1}{2}$–$\frac{3}{4}$ line long, rarely longer, *widely elliptical-oblong, rounded at apex and obtuse, apiculate or very shortly and widely*

pointed, not finely acuminate, narrowed at base; margin entire or slightly sinuose below, faintly, rarely more strongly, denticulate at apex; nerve wide at base, then becoming slender, reaching half-way or more. Cells linear-rhomboid, tapering but not acute, 8–15 times as long as wide, chlorophyllose, the walls firm; above shorter and wider, often very short at apex; at base laxer, the angular large, sub-rectangular, often hyaline, *forming more or less distinct, inflated, somewhat pellucid auricles.* Perichaetial bracts *entire, nerveless.* Seta ½–1 inch long; capsule reddish brown, black when old, oblong-cylindrical, arcuate; peristome large, orange. *Autoicous.*

Var. β. *complanatum* B. & S. Stems more elongated with fewer branches; leaves *sub-complanate, less concave.*

Var. γ. *julaceum* B. & S. Branches short, *julaceous, obtuse;* leaves *densely imbricated, cochleariform, obtuse.*

HAB. Rocks, base of walls, etc., in shady situations; common. The vars. more rare. Fr. late winter.

Usually known without much difficulty by its shining, close tufts, of a somewhat rigid texture, generally with a rusty reddish tinge, the branches usually more or less obtuse and julaceous, and the leaves always concave, so that they cannot be flattened out without splitting, at apex often cucullate, never longly nor finely acuminate, usually only very slightly acute. The fruit is usually produced in great abundance. The plant is distinctly a lowland one, rarely found at high altitudes, and it is always a rock-growing plant, preferring shady, moist situations, never or very rarely growing on trees.

It has some resemblance to *Brachythecium caespitosum* and *B. illecebrum;* the former however has usually (but not always) more slender branches, and the leaves are less concave, and more longly and acutely pointed; while the latter is a less glossy terrestrial plant of softer texture, the leaves usually larger, with more vermicular, narrower cells less tapering at the ends and less chlorophyllose. The fruiting characters are quite different.

The branches are often markedly julaceous, and it is difficult to draw the line between the type and the var. *julaceum.*

19. Eurhynchium confertum Milde (*Hypnum confertum* Dicks., Braithw. Br. M. Fl.; *Rhynchostegium confertum* B. & S., Schp. Syn.) (Tab. LV. E.).

In low, *dense* tufts, dull or (especially the tips of the branches) bright green, not very glossy, slender. Stems short (about 1 inch), irregularly branched, *prostrate and adhering by radicles,* branches slender, short, variously directed. Leaves not crowded, erecto-patent, usually somewhat secund, often strongly so, small, *about ½ line in length,* concave, ovate, ovate-oblong or ovate-lanceolate, *shortly acuminate,* denticulate over the greater part of the margin, nerve *reaching usually above the middle;* areolation resembling that of *E. murale,* the angular rather less distinct. Perichaetial bracts *denticulate, thinly nerved.* Seta about half an inch long, capsule short, ovate-oblong, brownish; peristome rather small. *Autoicous.*

Hab. Stones, stumps of trees, etc., in shady places; common. Fr. winter.

Allied to the last species, but differing in habit, the more pointed, less concave leaves, non-julaceous branches, and other points. It resembles *Brachythecium velutinum* in appearance, but has wider, less longly acuminate leaves, the seta smooth, the lid long-beaked, etc. It very frequently grows mixed with *Amblystegium serpens*.

A robust form with complanate leaves has been distinguished as var. *serrulatum* Brid.; it is quite distinct from the N. American *H. serrulatum* Hedw.

20. Eurhynchium megapolitanum Milde (*Hypnum megapolitanum* Bland., Braithw. Br. M. Fl.; *Rhynchostegium megapolitanum* B. & S., Schp. Syn.) (Tab. LV. F.).

Allied to *E. confertum*, of which it has been considered a variety, but very different in habit; *much more robust, in looser tufts, not adhering to the substratum by radicles*, though the stems may bear radicles at times; divisions long, 1–3 inches, more branched; pale or yellowish green, shining. Leaves more or less closely imbricated, appressed or divergent when dry, faintly or sharply denticulate, *larger*, ½–1 *line long*, rapidly narrowed and constricted at base, *decurrent*, widely ovate, *rapidly narrowed to a rather* long, narrow, sometimes half-twisted acumen; branch-leaves narrower, ovate-lanceolate, acuminate. Areolation resembling that of *E. confertum*, or rather wider, the angular cells more numerous and more distinct, usually opaque, often reaching to the nerve. Seta usually longer, often attaining 1 inch, or more, *flexuose*.

Hab. Stony and sandy ground, rarely on walls. Rare. Fr. winter.

Although allied to the last this appears to be quite distinct, and is so different in habit that it is not so likely to be mistaken for that as for some other species, *e.g.*, certain species of Brachythecium. It is, however, usually to be found in fruit, and there is then no difficulty in recognising it; and when barren may generally be known from any of the above-mentioned plants by the form of the leaf and basal areolation, which is more distinctly marked off from the rest of the cells than is usual in Brachythecium. The leaves are sometimes spreading and sub-complanate, sometimes densely imbricated and appressed so that the branches are terete.

It occurs, perhaps most frequently, on sandy and stony sea-shores.

21. Eurhynchium rotundifolium Milde (*Hypnum rotundifolium* Scop., Braithw. Br. M. Fl.; *Rhynchostegium rotundifolium* B. & S.) (Tab. LV. G.).

In small, soft, straggling tufts, stems creeping, with irregular, arched or sub-erect branches, *dull green*. Leaves loosely imbricated, when dry *not appressed but shrinking and twisted, soft and flaccid, ovate or rounded ovate, shortly pointed*, faintly

denticulate above, not concave, nerve thin, reaching to middle; areolation *very lax and wide*, thin-walled, *rhomboid-hexagonal, 12–15 μ wide*, 3–5 times as long, laxer and sub-rectangular at base, but not distinct at angles. Seta short, capsule small, oval-oblong. Autoicous.

HAB. On the ground in stony places, by roadsides, etc.; very rare. Near Wells (*Binstead*); Stroud (*Holmes and Elliott*). Fr. winter.

This very distinct species was added to our moss-flora a few years ago, by the Rev. C. H. Binstead. The short, rounded, flaccid leaves with extremely large cells render it a very marked plant; the cells in all the previously described species of the genus being less than half the width, and often much narrower.

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111. **SEMATOPHYLLUM** Mitt.

Slender mosses with creeping stems, resembling Eurhynchium (Rhynchostegium B. & S.). Leaves often secund or sub-complanate, *nerveless or shortly two-nerved*, areolation narrow, *with 3–8 large, inflated, pellucid cells at extreme basal angles.* Capsule small, oblong, *lid with a long slender beak*, seta usually smooth.

DERIV.—σηματο-(sēmato), mark, character, and φυλλον (phyllon) a leaf, from the distinct leaf structure.

A rather large and very natural genus, distinguished from Eurhynchium by the nerving and the large vesicular angular cells, from Hypnum, Plagiothecium and Amblystegium by the subulate lid. The generic name was somewhat unfortunately chosen by Mitten, since the authors of the Bry. Eur. defined and separated the species of the group as a sub-genus of Rhynchostegium under the name of Rhaphidostegium, which name might well have been retained for the genus.

{ Leaves narrowly ovate-lanceolate, acuminate, almost entire...*1. demissum*
{ Ls. widely ovate or rounded, widely pointed, denticulate.....*2. micans*

1. Sematophyllum demissum Mitt. (*Hypnum demissum* Wils.; *Rhynchostegium demissum* B. & S., Schp. Syn.; *Plagiothecium demissum* Dixon, Handb. Ed. I.) (Tab. LV. H.).

In dense, depressed or drooping tufts, *pale yellowish green or golden, shining;* stems prostrate or pendent, with short, irregular, slightly spreading or parallel branches; slender, 1–3 inches long. Leaves *imbricated all round the stem or more*

commonly secund, hardly altered when dry, losely set, *narrowly ovate or oblong-lanceolate from a narrow, not decurrent base*, shortly and rapidly acuminate, *pale, with usually a bright orange base*, obsoletely denticulate, somewhat concave; *nerveless or with faint traces of a single or double nerve;* margin reflexed below; cells narrowly linear-rhomboid, tapering, 8–12 times as long as broad, slightly laxer towards base; at mid-base two or three rows usually bright orange; angular cells *large, hyaline, very few*, a few marginal above these small, quadrate; median basal cells *enlarged, rectangular, orange*. Seta slender, flexuose, sub-erect or ascending, capsule small, lid conical with a long beak. *Autoicous*.

HAB. Wet, shady rocks, very rare; S.W. Ireland; N. Wales; Keswick. Fr. autumn.

This very rare and distinct plant is only found in Britain in the localities above-mentioned. It is very distinct in habit, mode of growth and especially in the basal areolation. *Plagiothecium Muehlenbeckii* shows a somewhat similar structure, but is known by the non-rostrate lid, striate capsules, and longly acuminate, toothed leaves. *S. demissum* grows on the inclined faces of rocks in wet situations, often turning a bright golden brown; it is usually closely attached to the surface of the rock. The fruit, which is rather small for the size of the plant, is somewhat copiously produced all along the stems.

It is a larger plant than the next, with quite different leaves.

2. Sematophyllum micans Braithw. (*Hypnum micans* Wils. *non* Swartz, Handb. Ed. I, et plur. auct.) (Tab. LV. I.).

Extremely slender, prostrate, 1–2 inches long, with few, procumbent or ascending, short, *filiform*, sometimes flagelliform branches, forming glossy, thin, flat patches of a golden green. Leaves erecto-patent or secund and pointing upwards, *minute*, hardly $\frac{1}{4}$-line long, *very widely ovate or rounded*, shortly and broadly but acutely pointed, concave; margin narrowly reflexed below, *distinctly denticulate, principally in the upper half;* nerve short and double, or none. Cells short, linear, rather incrassate, 6–10 times as long as wide, angular 6 to 8, *smaller than in the last species*, 15–18 μ in diameter, sub-quadrate, hyaline or golden, reaching some distance up the margin and towards the nerve; above passing abruptly into the narrow, linear-rhomboid cells. Capsule small, lid rather shortly rostrate. *Dioicous*.

HAB. On the face of wet rocks. Very rare; South of Ireland; North Wales; Borrowdale; West Highlands. Sterile in Britain.

This extremely rare and pretty species forms delicate patches closely applied to the rock surface, resembling *Hyp. cupressiforme* var. *filiforme*, but of a more golden colour, and quite different on closer inspection. The discovery of operculate capsules in the Alleghany Mts., U.S.A., has proved that it is out of place in Hypnum, and it finds its natural home in the present genus, side by side with *S. demissum*, than which it is a more delicate plant, with wider, sub-orbicular leaves and different basal areolation. It is quite distinct from any other of our mosses.

Herzog describes (Rev. Bry. 1901, p. 76) a var. *badense*, more robust, with well-defined double nerve and larger angular cells (30 μ in diameter). This is the only record of the plant on the continent; it is not rare in some parts of the U.S.A., where it has been known as *Hyp.* (*Rhynchostegium*) *Novae-Caesareae* Aust. It is perhaps somewhat unfortunate that Austin's specific name has not been kept up, as *H. micans* Wils. is antedated by *H. micans* Swartz (a species of Plagiothecium), and some confusion is likely to arise. The application of the Vienna Code may probably lead to the restoration of Austin's name.

British plants from Wales and Cumberland have been distributed as the var. *badense*, and appear to agree with the description; but it does not seem to me a well defined variety.

112. PLAGIOTHECIUM B. & S.

Stems irregularly branched, not pinnate. Leaves (in all the British species) *complanate or secund and homomallous*, ovate or oblong-lanceolate, often inserted obliquely and asymmetrical, *two-nerved or nerveless*, cells rhomboid-hexagonal or linear, usually very chlorophyllose. Seta *smooth*. Capsule *slender*, oblong-cylindric, more or less curved, smooth or striate; lid apiculate, acuminate, or rostellate, rarely rostrate or obtusely conical. Peristome more or less perfect, pale.

This genus is for the most part a very natural one, the greater number of species being very distinct in their flattened stems and branches with complanate leaves; there are, however, a few intermediate species between this genus and Eurhynchium, which seem best placed here, as they come very near some of the species whose position in the present genus is undoubted. I have thought it best to place here the species usually known as *Rhynchostegium depressum*. Its affinity to *Eurh. confertum* is undoubted, but it is also very near some of the species of Plagiothecium in habit, etc., and the complanate, almost nerveless leaves give it a marked claim to be included here. In the absence of marked structural characters in the fruit and in the areolation, to separate the genera of Hypnaceae, the character derived from the single nerve or otherwise would appear to be of considerable importance, judging from its constancy in some of the well-defined groups of Hypnum and in other genera of the Pleurocarps; I have therefore thought it the soundest method of classification (and it is also by far the most convenient to students) to include under Eurhynchium only those species with a single nerve (usually correlated with non-complanate leaves), and to unite with Plagiothecium the double-nerved or nerveless leaved species having the leaves complanate or more or less secund and homomallous. The rostrate lid of the species in question is of course no objection to this arrangement, as in other species of Plagiothecium it is quite as long.

P. Muehlenbeckii and *P. latebricola*, approaching Sematophyllum in the basal areolation, are distinguished by the shorter lid.

From Amblystegium the present genus differs in the longer, more rhomboid areolation, the nerve always double or wanting, the complanate or secund arrangement of the leaves, and the lid frequently longly acuminate and acute.

DERIV.—*πλαγιο-*(plagio) oblique, and *θηκιον* (thēkion) a little vessel; from the usually oblique capsule.

1 { Ls. concave, entire, abruptly piliferous.....*4. piliferum*
Ls. not abruptly piliferous (either short pointed or if acuminate gradually tapering and usually toothed).....2

2 { Ls. with angular cells enlarged, more or less decurrent.....3
Ls. without distinctly enlarged angular cells.....7

3 { Ls. over 1 line long, strongly complanate.....4
Ls. under 1 line long, indistinctly complanate or sub-secund.....6

4 { Ls. transversely undulate, plant robust, whitish.....*9. undulatum*
Ls. not undulate.....5

5 { Ls. glossy when dry; cells 10-12 μ wide; lid conical-acuminate *8. denticulatum*
Ls. shrinking, hardly glossy when dry; cells 15-18 μ wide; lid rostrate *8*. silvaticum*

6 { Ls. with serrulate acumen; capsule striated.....*7. Muehlenbeckii*
Ls. entire; capsule smooth.....*10. latebricola*

7 { Ls. strongly complanate; plant in flattened depressed tufts, or straggling.....8
Ls. more or less secund, or indistinctly complanate, tufts not flattened and depressed.....10

8 { Ls. contracted to a fine acumen.....9
Ls. acute, scarcely acuminate, entire or finely serrulate...*1. depressum*

9 { Ls. entire, outer cells of stem large.....*3. Muellerianum*
Ls. usually with a few teeth near apex; outer cells of stem narrow *2. elegans*

10 { Ls. with long serrulate acumen.....*6. silesiacum*
Ls. entire.....*5. pulchellum*

1. Plagiothecium depressum Dixon (*Hypnum depressum* Bruch; *Rhynchostegium depressum* B. & S., Schp. Syn.; *Isopterygium depressum* Mitt., Braithw. Br. M. Fl.) (Tab. LV. J.).

In *smooth, shining*, close tufts of a bright or golden green; branches slender, *procumbent*, almost simple, short. Leaves not decurrent, *sub-distichous, somewhat depressed on each side of the branches in two regular rows, or nearly complanate;* not crowded, hardly altered when dry, erecto-patent, oval-oblong, *acute or shortly acuminate*, concave, *faintly* (more rarely strongly) *denticulate in the upper half;* nerve *very short and double, or none;* cells linear-rhomboid, tapering at ends, 6–10 times as long as broad, very chlorophyllose; laxer and more

pellucid at base, *the angular hardly distinct from the other basal cells*. Seta short ; capsule oblong, lid longly and finely acuminate. *Dioicous*.

HAB. Foot of trees and shaded rocks in calcareous districts ; not common. Fr. very rare, winter.

Much resembling *Eurh. confertum* and other mosses in general aspect, form of leaf, etc., this species may be known from all the species of Eurhynchium by its nerveless or shortly two-nerved leaves, and also by its smooth flat tufts with nearly complanate parallel branches ; from *Plag. elegans*, which somewhat resembles it, it is known by the less pointed leaves with wider areolation ; *Plag. denticulatum* has almost always larger leaves, with larger cells, and the leaves are decurrent and have the margin recurved towards base. *Sematophyllum demissum* has quite different areolation, especially at the base, and is autoicous ; and the habit is quite distinct.

The cells in *P. depressum* are faintly and minutely papillose, each cell having a row of papillae—not a single one—on its face ; this being the only European species in which such a structure is found, though it occurs in numerous, but not closely allied, exotic mosses. The papillae however seem to disappear more or less after gathering, and can only be seen quite satisfactorily in fresh specimens. They are best observed by viewing the back of a *dry* leaf, in profile, with a high power.

2. Plagiothecium elegans Sull. (*Hypnum elegans* Hook. ; *Isopterygium elegans* Lindb., Braithw. Br. M. Fl. ; *Plag. Borrerianum* Spr., Handb. Ed. I., et mult. auct.) (Tab. LV. K.).

In smooth, low, dense silky patches of a *pale shining green ;* branches procumbent or ascending, mostly numerous, slender, pointing one way, almost simple, complanate. Stems 80–120 μ, rarely 150 μ in thickness, cells of outer layer thick-walled, *narrow*, scarcely wider than the basal leaf-cells. *Numerous axillary, gemmiform branchlets* are frequently present. Leaves subdistichous, *complanate*, or slightly depressed, the points *frequently pointing downwards*, not curved upwards, *hardly altered when dry and very glossy*, $\frac{1}{2}$–$\frac{3}{4}$ line long, ovate-oblong or oblong-lanceolate, gradually narrowing from about the middle, then *quickly narrowed to a rather short, fine, sometimes flexuose acumen*, rounded at base to a rather narrow, *not decurrent* insertion, one wing frequently inflexed, but plane at margin, entire except at the acumen, which is more or less distinctly denticulate, very rarely entire, most frequently with two or three distinct denticulations on each side some way below apex ; nerve double, short, frequently very faint ; occasionally longer and reaching half-way. Cells linear, pointed, *very narrow, 20–30 times as long as wide*, about 80 μ long and 4–7 μ wide ; *almost uniform to base*, or with a very few at basal angles sub-rectangular, but indistinct. Capsule *shortly and widely oval*, wide-mouthed and somewhat turbinate when empty, horizontal or sub-pendulous, hardly curved, smooth ; lid conical, obtusely pointed. Peristome yellow. *Dioicous*.

Var. *β. collinum* Wils. Branches *erect*, leaves *sub-secund*.

HAB. On the ground in woods, on non-calcareous rocks, etc.; principally in mountainous districts. Frequent. The var. *β* rare. Fr. very rare, spring.

There has been much diversity of opinion as to the identity or non-identity of our European moss with the American plant described by Hooker under the name of *Hypnum elegans*. Spruce, who first described the European plant, remained of the opinion that the two were distinct, pointing out distinguishing characters; but it seems to be shown that they are actually identical, and I have restored the original name.

P. elegans may usually be recognised without much difficulty by the small, non-decurrent, narrowly tapering leaves, and very narrow areolation. *P. silesiacum*, *P. Muellerianum*, *P. denticulatum*, and *P. depressum* are the only ones which are at all liable to be confounded with it; the differences between it and the two former are pointed out under those species. *P. denticulatum* is as a rule larger, with larger, more shortly and widely pointed leaves, having much laxer areolation, the cells more than twice as long and twice or even four times as wide; in the var. *aptychus* however there is a much nearer approach to the present plant; but the leaves are rarely so finely pointed, the cells, so far as I have observed them, are hardly ever less than 120 μ in length, usually 140-160 μ in the smallest forms, and 5-7 μ wide at least, whereas in the present species they are distinctly shorter and constantly narrow, while the basal areolation and structure is quite distinct, the present plant having the leaves rounded and narrowed at base to the insertion, and not decurrent, with the cells almost uniform to the base, while in *P. denticulatum* they are not rounded at the angles, but straight, decurrent, and with much laxer basal cells. The inflorescence is also an important character. The fruit is quite distinct, but is very rarely found.

P. depressum is much like the present species in habit, but the leaves are smaller, narrower, and not finely acuminate, with much shorter and wider cells. *P. Muehlenbeckii* differs in the inflated angular cells, autoicous inflorescence and striated capsule.

P. elegans usually produces bundles of fusiform offshoots in the axils of the leaves, bearing minute rudimentary leaves; these are sometimes very abundant and conspicuous, and may then be relied upon as a distinctive character, though they are not always present.

3. **Plagiothecium Muellerianum** Schp. (*Isopterygium Muelleri* Lindb., Braithw. Br. M. Fl.) (Tab. LV. L.).

In pale or yellowish green, *very glossy*, lax patches, *with long, straggling, simple, flattened branches*, 1-2 inches long or more; frequently very slender with *dense small-leaved flagelliform branchlets;* stems and branches thick, *150–200 μ in diameter*, frequently more; cells of outer layer *very large, thin-walled*, 16–28 μ wide, 3–4 times the width of the lower basal cells. Leaves rigid, scarcely altered when dry, less divergent than in the allied plants, *pointing forward and usually curved upwards at the points so that the surface of the frond is concave;* ovate-lanceolate, gradually narrowed upwards, then rather abruptly longly apiculate; concave, not decurrent; margin plane, *quite entire;* nerve double, extremely faint and short. Cells *very narrow*,

80-100 μ long and 3–5 μ *wide*, scarcely altered at base and angles. Capsule very small, smooth, erect or inclined, lid shortly and obtusely rostellate. Dioicous.

HAB. In crevices of rocks and in rotting stumps at high altitudes, very rare; Perthshire; Argyllshire; Sutherland. Fr. late autumn, not found in Britain.

A rare and till recently little understood moss, owing to its frequent appearance in a reduced flagelliform state, in which condition it resembles *P. pulchellum* var. *nitidulum*, with which it has been usually compared. In its typical growth however it is a very different and much larger plant, in its denser forms superficially resembling *P. elegans*, but as a rule of much more straggling growth, highly glossy, and always recognisable at once by the stout stem and the form of the frond, which is usually concave above, and always narrow in proportion to the length of the leaves, and quite distinct from any of our other species of Plagiothecium, *P. silesiacum* differing entirely in the much less rigid, more flexuose, toothed, longly acuminate leaves and non-complanate branches. The cells are narrower than in any of our other species, and the large "sphagnoid" outer cells of the stem will separate it in all its forms from the allied plants. (Tab. LV. L, shows these cuticular cells in juxtaposition to the basal leaf cells for comparison, but it must not be supposed that they are detached from the stem by the removal of the leaf.) *P. Muellerianum* fruits very rarely and usually sparingly. *P. pulchellum* and its var. *nitidulum* sometimes grow mixed with it, and are a little difficult at times to separate.

4. Plagiothecium piliferum B. & S. (*Leskea pilifera* Swartz). (Tab. LV. M.).

In flat tufts, bright green or yellowish, *glossy*; intermediate in size and habit between *P. denticulatum* and *P. elegans*. Leaves sub-complanate, not widely spreading, widely ovate-oblong, *very concave, abruptly contracted to a flexuose piliform point of varying length*, at base *very narrowly decurrent*; margin *entire, very narrowly recurved for the greater part of its length*; nerve very short and double, or obsolete. Cells very narrow, 4–6 μ wide, and 50-70 μ long, very little altered to base, at extreme basal angles a few wide, rectangular, hyaline. Seta rather short, slender, pale red. Capsule pale brown, thin-walled, narrow, with a distinct tapering neck, sub-erect or more inclined, symmetrical or somewhat curved, when dry slightly contracted below the mouth, faintly and irregularly striate. Lid conical, not very acute. Peristome pale, cilia *wanting*. *Autoicous*.

HAB. Among boulders and in rock crevices on mountains; very rare; Ben Lawers, 1902 (*Duncan and Jones*). Fr. summer.

A widely spread moss among the higher mountain ranges of the Continent, but unknown in Britain until detected by Mr. J. B. Duncan in some gatherings made upon Ben Lawers as recorded above. The concave, piliferous leaves render it easy of recognition, although the hair-points may be very inconspicuous upon some branches. It usually fruits freely.

5. Plagiothecium pulchellum B. & S. (*Hypnum pulchellum* Dicks.; *Isopterygium pulchellum* Lindb., Braithw. Br. M. Fl.) (Tab. LV. N.).

Very slender, forming small tufts of a bright green, *with a metallic sheen when dry*, often intermixed with other mosses. Stems creeping, short, with numerous *erect, curved, very slender* branches, $\frac{1}{2}$-inch long or less. Branch-leaves $\frac{1}{2}$ line long, *usually slightly falcate and regularly homomallous*, not complanate, hardly altered when dry, very glossy, *narrowly triangular, gradually narrowed from immediately above the wide, not excavate nor decurrent base*, to a very fine but not very long acumen, *entire*, plane at margin, nerveless or with very faint traces of a nerve. Cells linear, extremely narrow, 5–8 μ wide and 15–20 times as long or more, pointed, almost uniform; about two rows at base short, wider, sub-oval, but *not distinct at angles nor forming auricles*. Seta slender, $\frac{1}{2}$–$\frac{3}{4}$ inch long, capsule small, very variable, usually oblong with a tapering neck, sub-erect and slightly curved, with a rather wide mouth; sometimes very short, almost symmetrical, or more strongly curved, and almost horizontal, frequently hardly tapering at neck, especially before the fall of the lid; greenish brown, reddish brown when empty. Lid conical, apiculate. Peristome teeth *densely barred;* cilia moderately developed. *Autoicous.*

Var. *β. nitidulum* Husn. (*Hypnum nitidulum* Wahl.; *Plag. nitidulum* B. & S., Schp. Syn.; *Isopterygium pulchellum* var. *nitidum* Lindb., Braithw. Br. M. Fl.). In *flatter, more prostrate and straggling tufts*, branches spreading, not erect, *complanate*, leaves *sub-distichous*.

Hab. Crevices of rocks and among mosses on mountains, frequent. The var. *β* more rare. Fr. summer.

A very pretty species, sometimes forming rather dense tufts, at others growing intermixed with other mosses, among which it interlaces itself and becomes inconspicuous. The leaves are usually described as sub-complanate and rarely sub-secund, but in every specimen I have seen, when not distinctly the var. *nitidulum*, they are markedly homomallous, although with a somewhat distichous insertion; and any tendency to spread out and become complanate is distinctly exceptional. The variety is very different in habit from the usual form, with the leaves regularly complanate and the branches therefore flattened, prostrate, and not erect nor ascending; the leaves are perhaps a little larger and more longly acuminate in general, and the colour often of a deeper green, but even these characters are inconstant, and the others frequently given, as to the form and direction of the capsule, the aggregation or otherwise of the male flowers, are quite valueless.

If attention be paid to the form of the leaf, especially at its base, there will be no difficulty in distinguishing this species from all the allied plants; in *P. latebricola* and others the leaves are *ovate*-lanceolate and decurrent. *P. elegans* is usually larger, with the leaves wider, complanate or decurved, almost always denticulate above. *P. Muellerianum* in its slender forms alone can be mistaken for it, but is known under the microscope by the still narrower areolation and large cuticular cells of the stem and branches. *Hypnum incurvatum* differs in the leaves not sub-distichous nor complanate, more narrowly lanceolate with numerous distinct angular cells.

6. Plagiothecium silesiacum B. & S. (*Hypnum silesiacum* Selig. ; *Isopterygium repens* Lindb., Braithw. Br. M. Fl.) (Tab. LV. O.).

Moderately robust, stem creeping, with irregular branches ½–1 inch long, procumbent and often rooting at their tips, frequently attenuated at apex ; forming flat, loose, shining tufts, pale or yellowish green. Branch-leaves spreading when dry, more strongly so when moist, frequently somewhat distichous and complanate at base, almost always *secund and curved upwards at the points*, especially towards the tips of the branches ; ¾ *line long or rather more*, triangular-lanceolate or oblong-lanceolate, tapering to a long, *narrow*, almost *filiform acumen*, flexuose when dry, at base slightly narrowed, *not decurrent* and hardly excavate ; margin plane, denticulate, *the acumen rather remotely and sharply toothed ;* nerve double, short and faint. Cells linear, 10–15 times as long as wide, laxer towards base, a few at extreme base sub-rectangular, but hardly distinct. Seta ¾–1 inch long ; capsule rather large, *1 line long*, cylindric, curved, not striate ; lid conical, *obtuse*. Peristome teeth densely barred ; cilia well developed. *Autoicous*.

HAB. Rotten tree trunks in woods, principally in sub-alpine districts. Very rare ; Kent ; Yorkshire. Fr. summer.

Known from *P. Muehlenbeckii* by the smooth capsule and the absence of distinct angular cells ; from *P. elegans* by the secund, more flexuose leaves curved upwards, with longer, more tapering acumen, and especially by the autoicous inflorescence ; from *P. Muellerianum*, *P. pulchellum*, and *P. latebricola* by the larger size, larger, toothed leaves, etc. The remaining species have the leaves shortly pointed, not longly acuminate.

7. Plagiothecium Muehlenbeckii B. & S. (*Hypnum Muehlenbeckii* Hartm. ; *Plagiothecium striatellum* Lindb., Handb. Ed. I., Braithw. Br. M. Fl.) (Tab. LVI. A.).

Slender, in rather dense low tufts, dark or yellowish green, shining. Branches ascending, straight or slightly curved, brittle ; branch-leaves imbricated in two rows, complanate or secund with the points curved upwards, *widely ovate-acuminate or sometimes triangular-ovate*, tapering to a *long fine acumen* which is flexuose and shining when dry, serrulate at margin, especially above, very faintly two-nerved ; margin plane. Cells *rather short*, 8–15 times as long as broad, linear, slightly laxer at base, at basal angles wider, sub-rectangular, then *suddenly large, inflated, hyaline or orange, few, forming very distinct decurrent auricles*. Capsule oblong-cylindric with a tapering neck, curved, at first smooth, when empty *irregularly but distinctly striate ;* lid conical, rather obtuse. Autoicous.

Hab. On the ground and rocks on mountains, rare; Highlands of Scotland. Fr. autumn.

Resembling *P. silesiacum*, to which it is indeed allied, but more slender, with distinctly wider, more complanate leaves, smaller striated capsules, and especially characterised by the inflated hyaline cells, clearly marked off from the other basal cells, and forming the decurrent part of the leaf-base. It is somewhat variable in size, mode of growth and colour. I have gathered a compact form on Ben More in Sutherland with the branches all erect and densely crowded.

The specific name *striatellum* has priority over *Muehlenbeckii*, and may have to be re-instated.

8. Plagiothecium denticulatum B. & S. (*Hypnum denticulatum* L.; *P. trichodeum* Stirt. in Ann. Scot. Nat. Hist. xv, 113) (Tab. LVI. B.).

Very variable; the following description applies to what may be considered the most typical group of forms (sub-spec. *sulcatum* Spruce). Tufts flattened, pale shining green, especially when dry; moderately robust, branches ascending, complanate, more or less elongated. Leaves of branches not crowded, *sub-distichous and complanate*, somewhat spreading, *when dry little altered, usually slightly waved but not much shrunken, glossy*, usually slightly concave, large, $\frac{3}{4}$–$1\frac{1}{4}$ lines long, oval-oblong or widely oblong-lanceolate, *shortly acute, scarcely acuminate, rather wide and decurrent at base, with one or both margins very narrowly recurved*, entire except at the extreme tip, where there are almost constantly a very few distinct denticulations; nerve variable, forked, almost obsolete or reaching (one or both branches) to a third the length of the leaf. Cells *hexagonal-rhomboid, large, wide, 10–15 times as long as broad*, 120–160 μ long, *10–15 μ wide*, very chlorophyllose, thin-walled; gradually becoming *laxer, more rectangular and pellucid at base*, the angular especially large, sub-rectangular, hyaline, decurrent, but not clearly defined from the rest of the basal cells. Seta long, 1–$1\frac{1}{2}$ inches; capsule rather large, about 1 line long, sub-erect, cylindrical with a distinct neck, dull brown, *slightly curved or nearly straight, distinctly striate when dry and empty*. Lid conical, *obtusely or acutely acuminate, or rostellate*. *Autoicous*, male flowers near the perichaetium.

Var. β. *aptychus* Spr. (*as sub-spec.*). Smaller; leaves narrower, more narrowly acute or shortly acuminate, *the points often hooked and decurved*, cells *narrower, 6–10 μ wide*. Seta shorter, capsule *small*, ($\frac{3}{4}$ line) horizontal, oblong, neck indistinct or none; when dry and empty wide-mouthed, oblong-cylindrical, *strongly curved, not striate*, brown at back, usually paler below; lid conical, *hardly acuminate, short*.

Var. γ. *majus* Boul. (*P. rufo-virescens* Stirt. in Ann. Scot. Nat. Hist. xix, 242). *Tall, luxuriant*, 2–5 inches long. Leaves

large, somewhat tapering and acute, *usually shrinking considerably when dry*, the nerve usually long and distinct, cells *large*, *wide*, capsule large, *long*, narrowly cylindrical, arcuate, *striate ;* lid rostellate, *the beak often long*.

Var. δ. *obtusifolium* Hook. & Tayl. (var. *Donii* Lindb., Braithw. Br. M. Fl. ; *P. Kinlayanum* Stirt. in Ann. Scot. Nat. Hist. xiv, 104 ; *Hypnum annotinum* Stirt. in Trans. & Proc. Bot. Soc. Edin. xi, 75). Leaves *concave*, *shortly and widely ovate*, *rounded at apex and minutely apiculate*, or rarely obtuse, not tapering nor acuminate, soft ; cells *lax*.

HAB. On the ground, roots of trees, rocks, etc., chiefly in woods. Common. The var. *aptychus* much less common. The var. *majus* in damp mountainous woods, frequent. The var. *obtusifolium* on mountains, not common. Fr. summer.

In addition to the above-mentioned varieties there are numerous other forms which have been named and described of more or less importance ; the var. *densum* Schp., a short, closely tufted form with short branches and crowded leaves, is one of the most marked ; I have gathered this with very small, smooth, almost symmetrical capsules as described by Schimper, etc., and if this is a constant accompaniment the plant would be well deserving rank as a variety ; Spruce, however, mentions it as possibly belonging to his sub-species *sulcatum* (the type as described in this work), and should forms occur with the capsules striated, the plant would have to be looked upon as only a dwarf form.

I have generally found the typical form and the var. *aptychus* very distinct but Mr. Bagnall told me that he found both smooth and striate capsules in the same tuft, and I have several specimens with "*sulcatum*" leaves but smooth capsule ; the leaf characters of var. *aptychus* are however well marked, and on the whole this variety appears to be a very distinct one. As pointed out by Spruce, hooked leaves are in this species usually correlated with a hooked capsule.

In reference to the var *obtusifolium* Hook. & Tayl., Spruce observes that he has never seen any form with obtuse leaves as described above, and is it certainly true that in the form in question the leaves, while rounded at the summit, are usually apiculate, but I have gathered this variety on Ben Lawers and elsewhere bearing some leaves which are actually obtuse, and, if the name be somewhat ill-chosen, the variety is a fairly well-marked one ; it appears to be usually barren, and is mostly of a deep green colour and soft in texture.

The present species is sometimes so slender as to resemble *P. pulchellum*, *P. elegans*, etc., but may always be known by its decurrent leaves with large wide cells and lax basal areolation, except as regards *P. silvaticum*. For its relationship to the latter the student is referred below.

* **Plagiothecium silvaticum** B. & S. (*Hypnum sylvaticum* L). (Tab. LVI. C.).

Closely allied to *P. denticulatum*, and sometimes hardly or not separable from the var. *majus* of that plant except by the dioicous inflorescence and the always smooth capsule. It is usually, however, very different in habit from ordinary *P. denticulatum*, and will as a rule be easily identified from the following description. Tufts large, *dull deep olive green*, *usually*

with a lurid yellowish tinge ; more robust than *P. denticulatum*, the leaves larger, less regularly complanate, but not hooked nor sub-secund, *widely spreading, when dry much shrinking and somewhat twisted*, so as not to overlap one another and thus appearing distant, *not or scarcely glossy*, 1–1½ lines long, widely ovate-lanceolate, more narrowed at the base and more tapering above, acute, entire or obsoletely denticulate at apex, *margin plane*, nerve usually very faint ; cells *large, wide*, hexagonal-rhomboid, 8–10 times as long as wide, 100–160 μ long, *about 16 μ in diameter*. Seta long, capsule large, 1¼ lines long, cylindrical with a tapering neck, inclined, slightly curved, *smooth, not striate ;* lid conical *with a more or less elongated beak, sometimes distinctly rostrate. Dioicous ;* male flowers numerous on the lower half of the branches.

Var. *β. Sullivantiae* Spr. (*Plag. Sullivantiae* Schp. ; var. *Roesii* Lindb., Braithw. Br. M. Fl.). Leaves *glossy when dry*, less distinctly complanate ; nerve *long* and rather strong, cells *narrower*, lid *shorter*.

Var. *γ. succulentum* Wils. (*Plag. succulentum* Lindb., Braithw. Br. M. Fl.). Robust ; leaves large ; *fertile flowers large, tumid*, occasionally synoicous.

Hab. Peaty soil, rocks, etc., in woods. Common. The var. *β*, Kirkstone Pass (*Stabler*); Cheshire ; the var. *γ* very rare; Cornwall ; North of England ; N. Wales. Fr. rather rare, summer.

The above description will render it as a rule fairly easy to distinguish the present plant from *P. denticulatum*, especial attention being paid to the general colour and dullness of the tufts, the leaves much shrinking and scarcely glossy when dry, the plane margins and lax cells, the smooth capsule, long lid, and dioicous inflorescence. When a difficulty arises it is not, as a rule, owing to this plant approaching *P. denticulatum ;* for although a somewhat variable moss, the varieties of *P. silvaticum* depend as a rule on structural details rather than on difference of habit, and its general appearance is a fairly constant one. (A form with erect branches and leaves scarcely complanate, var. *orthocladum* Schp., has been gathered in Caithness by the Rev. D. Lillie.) But *P. denticulatum* is extremely multiform in habit as well as other points, and in the var. *majus* especially it approaches so near *P. silvaticum* that one is finally obliged to admit that there is nothing but the difference of inflorescence, and perhaps the striation or otherwise of the capsule, to separate the two. (Even the inflorescence has been shown to be at times very unstable ; cf. Rev. Bry., 1902, p. 115.) The leaves in that variety are often shrunken when dry exactly as in *P. silvaticum*, with a varying, often slight degree of glossiness, the cells large, fully as wide as in this plant, the margin often plane, the capsule long and narrow, the lid decidedly rostrate ; it thus recedes far from typical *P. denticulatum*, which is at once recognised by its pale shining leaves, hardly altered when dry, and other points. As regards the capsule, almost every author describes that of *P. silvaticum* as smooth or striated, Limpricht describes it as striated only, and Husnot figures it with striae ; Spruce however declared that he had never seen a dioicous plant bearing the ordinary characters of *P. silvaticum*, which had striated capsules, and my own observation entirely supports this view. The discrepancy can perhaps be accounted for on the supposition that the various authors in question have assumed luxuriant forms of *P. denticulatum* (the var. *majus*

Boul.) to be the dioicous *P. silvaticum*, with striate capsules ; this assumption, though seemingly a bold one, is the less so from the fact that the resemblance of *P. denticulatum* in the above forms to *P. silvaticum* in foliage, lid of capsules, etc., has been very little realised until lately, most authors giving the shrinking leaves, wide cells and longly-beaked lid as confined to and characteristic of *P. silvaticum*, whereas there is not the least doubt that they are found equally on autoicous plants, belonging therefore to *P. denticulatum*. I am therefore inclined to think with Spruce that a striate capsule has not as yet been clearly proved to be ever associated with a dioicous inflorescence, at all events in our British plants,—the continental plants of this group seem to differ curiously from ours ;—in any case the character cannot be held a very important or a very useful one, since both forms of capsule occur in *P. denticulatum*.

The var. *Sullivantiae* supplies an additional argument in favour of uniting the present plant with *P. denticulatum*, since it approaches the latter in the glossy leaves, short lid, etc., in just those characters which are held to be the most constant as distinguishing the two, with the exception of the inflorescence.

Specimens of the var. *succulentum* which I gathered at Aber, in 1892, and which were verified by Boswell, have the flowers all with archegonia only, so far as examined ; it appears to be only by exception, and possibly a pathological condition, that the flowers in Wilson's and continental specimens are occasionally synoicous.

P. silvaticum is usually found barren, but when fertile the fruit is produced in abundance.

9. **Plagiothecium undulatum** B. & S. (*Hypnum undulatum* L.) (Tab. LVI. E.).

Robust, in large soft spreading masses, the branches long, broad, flat, frondiform, *2–4 inches long or even more*, procumbent, *pale green or, especially when dry, almost white*, hardly glossy. Leaves very large, *1½–2 lines long*, complanate, *strongly transversely undulate*, when dry little altered, often flexuose and incurved at the tips, widely ovate-oblong, broadest near the base and thence gradually narrowed but not tapering, at apex shortly and narrowly acuminate or merely acute, entire or with a few denticulations at the tip, rounded at base, to a narrow *decurrent* insertion, shortly two-nerved. Cells large, linear with longly tapering ends, thin-walled, 15–20 times as long as broad, at mid-base becoming shorter and laxer, at decurrent angles rectangular, hyaline, but not well-defined from the others. Seta long, *1½–2 inches ;* capsule large, *1¼–2 lines long*, cylindrical, curved and inclined, sometimes strongly arcuate and horizontal when empty, *striated* when ripe ; lid conical with a rather stout and moderately long beak. Dioicous.

HAB. Damp rocks and on the ground, principally in mountain woods. Frequent. Fr. summer, not uncommon.

A splendid plant when growing and fruiting luxuriantly, as it may frequently be found in rocky hollows and wet banks in woods on our mountains ; it is perhaps more like *Neckera crispa* than any of our mosses, but cannot be mistaken for that or any other species, the large size and pale colour making it at once conspicuous. It does not vary greatly, but in open

places the leaves sometimes become imbricated all round the stem, not complanate ; and when this is accompanied by a dry habitat the branches may become shorter, the leaves denser, and the plant has a close superficial resemblance to *Aulacomnium turgidum*. It occurs in lowland woods, etc., but is then generally barren ; in more elevated localities the fruit is not, however, uncommon.

10. Plagiothecium latebricola B. & S. (*Leskea latebricola* Wils.) (Tab. LVI. D.).

Slender, in small dense tufts, of a bright, shining, often yellowish green. Stems with numerous branches, short, hardly 1 inch long. Leaves sub-complanate, concave, spreading at the points and often sub-secund, *small* (about ½ line), *ovate-lanceolate, more or less finely acuminate, decurrent at base, entire*, plane or slightly revolute at margin, nerve very short and faint, sometimes almost wanting ; cells linear, pointed, thin-walled, about 15 times as long as wide, laxer at base, at decurrent angles *large, well-defined*, rectangular, *hyaline*. Seta short, capsule small, oblong, *erect, symmetrical ;* lid conical, apiculate. Peristome teeth linear, *remotely barred ;* cilia none or rudimentary. Dioicous.

Hab. On decaying wood, roots of ferns, etc., in woods, in moist situations ; rare. Fr. summer.

A slender, delicate plant, growing in similar situations and often in company with *P. denticulatum*. It is most like *P. pulchellum*, but will be recognised by the *ovate*-lanceolate leaves distinctly decurrent at base with large hyaline cells.

The *forma gemmascens* Ryan & Hagen, with numerous cylindrical green jointed gemmae from the tips of the leaves or axillary, has been gathered in Kent and Sussex.

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113. AMBLYSTEGIUM B. & S.

Plants of differing habit and branching, rarely pinnate ; as a rule preferring moist situations. Leaves usually small, mostly *more or less ovate-acuminate*, usually imbricated all round the stems, *not complanate nor strongly falcate*, though frequently moderately falcato-secund ; nerve *single or rarely none*. Cells *more or less parenchymatous, short, often less than 5 times as long as wide, rhomboid-hexagonal*. Seta *smooth ;* capsule narrow, more or less cylindrical, usually curved ; lid *conical, obtuse or apiculate*, rarely more longly acuminate.

An ill-defined genus, founded by Bruch & Schimper principally on the mode of branching (not pinnate as frequently in Hypnum), the areolation, and the short, not rostrate lid. I have followed De Notaris and Husnot in placing here *Hypnum*

filicinum and the allied species with similar areolation ; in spite of its resemblance to *H. commutatum* the areolation must be held of more importance, and *H. filicinum* is clearly in an anomalous position, from this point of view, when placed in that group. Its affinity to *A. irriguum*, etc., is also obvious, and I think nothing is lost by making this change ; while by so doing and by removing *A. riparium* to Hypnum the present genus is rendered a fairly natural one, based principally on this character of the cell structure. The latter species is clearly in an anomalous position in the present genus, the areolation being totally distinct and much more like that of *Hypnum aduncum*, which some of its forms closely resemble, but to which it can hardly be considered nearly allied ; it appears to be more at home in the Section Campylium of Hypnum, in which place it will be found in the present work.

The distinguishing characters of this genus, as regards our British species, will, if kept in mind, make it easy to recognise almost any plant which belongs to it, when the fruit is present ; these are the curved, sub-cylindrical, narrow capsule, non-rostrate lid, smooth, short cells and non-complanate leaves ; these characters will distinguish Amblystegium from any of the previously described pleurocarpous mosses. In the case of Hypnum it is very rare that the cells are short and wide as in the present genus, but in these few cases, as well as in the case of barren plants, experience will sometimes alone make it possible to recognise a species as belonging here, at sight, or without careful examination. As a consequence of the character of the areolation, the leaves in this genus are rarely glossy as is usually the case in the preceding genera of Hypnaceae.

DERIV.—ἀμβλυ- (ambly) blunt, and στεγεον (stegeon) a roof, lid ; from the form of the lid.

1 { Ls. nerveless ; plant very small and slender....2
  { Ls. single-nerved half-way or more....3

2 { Perichaetial ls. toothed ; ls. erecto-patent; dioicous.... *1. Sprucei*
  { Perichaetial ls. entire ; ls. sub-secund ; autoicous....*2. confervoides*

3 { Angular cells of ls. hyaline, forming distinct auricles....4
  { Angular cells not forming distinct auricles....5

4 { Stem radiculose and with paraphyllia ; nerve thick....*9. filicinum*
  { Stem scarcely radiculose, without paraphyllia....*10. curvicaule*

5 { Nerve slender, reaching ½ or ¾ up leaf....6
  { Nerve reaching nearly or quite to apex....8

6 { Ls. widely spreading when dry, marginal cells at base rectangular....7
  { Ls. not widely spreading when dry ; marginal cells at base quadrate *4. serpens*

7 { Ls. under ½ line long, ovate-lanceolate....*4*. Juratzkanum*
  { Ls. over ½ line long, cordate-ovate....*5. Kochii*

8 { Plants slender, not aquatic....9
  { Plants robust, more or less aquatic....10

9 { Very small, cells 6-10 times as long as wide.....*3. compactum*
  { Larger, cells 3-4 times as long as wide.....*6. varium*

10 { Leaves oblong-lanceolate, widely pointed.....*8. fluviatile*
   { Ls. widely ovate-lanceolate, smaller, acute.....*7. irriguum*

1. Amblystegium Sprucei B. & S. (*Leskea Sprucei* Bruch). (Tab. LVI. F.).

Extremely minute, forming small patches of a *pale green;* stems *filiform, very delicate*, irregularly branched, fragile; leaves *distant, erecto-patent when moist and when dry, minute, less than* $\frac{1}{4}$ *line in length*, ovate-lanceolate on the stems, lanceolate-acuminate on the branches, *all narrowly acuminate, nerveless*, plane at margin and almost entire or more frequently faintly denticulate or sinuolate; cells irregularly hexagonal-rhomboid, 3–6 times as long as broad, pellucid, with firm walls; at apex elongate, linear; at basal angles *a few slightly wider and rectangular*, but not distinct. Perichaetial leaves *finely toothed*. Seta very short, capsule minute, *erect or sub-erect, hardly curved*, obovate, somewhat turbinate when ripe and empty; inner peristome *without cilia. Dioicous.*

Hab. Shady sub-alpine rocks, very rare; principally in the North of England; Wales; Scotland. Fruit very rare, in summer.

The most minute of our pleurocarpous mosses, and only approached for delicacy by the next species, and occasionally by slender forms of *A. serpens*, of *A. filicinum* and of *Heterocladium heteropterum* especially in its var. *fallax;* this however is at once known by its dark green colour and non-acuminate, papillose branch-leaves. *A. serpens* and *A. filicinum* differ in the constant presence of a nerve, however faint; *A. confervoides* in the inflorescence, the curved, sub-horizontal capsule, entire leaves and shorter cells. An allied species, frequent on the continent, *A. subtile*, is slightly more robust, with rather larger less distant leaves, showing a faint trace of a nerve, and autoicous, intermediate indeed between this and *A. serpens*.

Cheney (N. Amer. species of Amblystegium, Bot. Gazette, Oct., 1897) points out leaf characters by which *A. Sprucei* and *A. confervoides* may be distinguished. I do not think the serration of the leaf margin is altogether safe, as in *A. Sprucei* the denticulation is at times almost obsolete; but the general shortness of the cells in *A. confervoides* seems a constant character, especially the large number of more or less quadrate angular cells; in *A. Sprucei* they are few, and often more or less elongate; and the general areolation, the apical especially, longer. Limpricht however points out a good character by which fruiting plants or ones with female flowers may be distinguished, the perichaetial bracts here being fringed with short very fine teeth, which is not the case with *A. confervoides*.

2. Amblystegium confervoides B. & S. (*Hypnum confervoides* Brid.) (Tab. LVI. G.).

Minute, resembling the last species; of a *rather deeper green*, the leaves slightly less distant, *more appressed both when moist and especially when dry*, about the same size but variable,

entire or almost so, more shortly and less finely acuminate, cells all *shorter,* at angles *sub-quadrate, numerous,* at apex *shorter, scarcely more than twice as long as wide.* Perichaetial bracts *entire.* Capsule *cernuous and sub-horizontal, curved,* oblong, very small; cilia of inner peristome *present,* 1–3. *Autoicous.*

HAB. In similar situations, principally on calcareous rocks, very rare. Fr. summer.

The fruiting characters are the most important and the most constant, but barren plants may be separated from *A. Sprucei* by the characters italicised, as pointed out above.

3. Amblystegium compactum Aust. (*Hypnum serpens* var. *compactum* Hook.; *H. compactum* C. M.) (Tab. LVI. H.).

Intermediate in size between *A. Sprucei* and *A. serpens,* but variable, and sometimes as delicate as the former; in pale green intricate patches, yellowish within; fragile. Stems slightly radiculose, creeping, irregularly branched. Leaves erecto-patent, usually slightly secund and pointing upwards on the branches, very narrowly decurrent; stem-leaves ovate-lanceolate, *gradually tapering to a variable, long, but usually rather wide and sub-linear acumen,* ¾–1 mm. long, *more or less sharply but finely denticulate throughout,* especially towards base where the teeth are *frequently recurved.* Nerve *broad, not tapering above,* rather ill-defined, *reaching high into acumen or percurrent,* at times indistinct in mid-leaf and re-appearing above; frequently *with delicate jointed brood-filaments from the back or apex* (Fig. 10). Branch-leaves narrower, sometimes very small. Cells *linear-rhomboid,* thin-walled, *6–10 times as long as wide,* at apex rather shorter, at angles shortly rectangular, not very distinct nor much enlarged. Seta short. Capsule small, erect or slightly inclined, nearly symmetric. Lid conical, apiculate. Autoicous or sometimes dioicous.

HAB. Limestone caves, tufa, etc. Very rare. Durness and Inchnadamph, Sutherland, and Dove Dale, Derbyshire (*Dixon, 1899*); Gloucestershire (*Knight*); Worcestershire (*Duncan*); Lancashire (*Wheldon & Wilson*). Fr. not known in Europe.

A delicate plant, distinct in some of its features, but not easy to describe. The cells are more elongated and narrower than in any of the allied plants of the same delicate build, and the long and rather peculiar nerve is distinctive. The brood-filaments (Fig. 10) are also characteristic, though not very abundantly produced. *Heterocladium heteropterum* var. *fallax* differs in the shorter nerve and cells, *A. filicinum* var. *trichodes* in the shorter, wider cells, *A. serpens* in the shorter nerve and different areolation, *A. varium* in the entirely different cells. The rather wide, scarcely tapering acumen is also a marked character.

There can be scarcely any doubt that our European plant is identical with the American *A. compactum*, which however is usually though not always autoicous, while our plant is apparently always dioicous (cf. Journ. of Bot., 1900, p. 175). It is found in several localities on the continent.

4. Amblystegium serpens B. & S. (*Hypnum serpens* L.) (Tab. LVI. I.).

Stems prostrate, rooting, *slender*, with numerous erect or spreading, slender, often filiform branches, forming very low soft tufts of a *dull or yellowish not shining green*. Leaves crowded, variously spreading when moist, when dry usually appressed and imbricated so as to give the branches a somewhat catenulate appearance, frequently however remaining more or less erecto-patent but rarely widely spreading and never squarrose, very rarely slightly secund; *ovate-lanceolate or ovate-acuminate* (those on the branches narrower, lanceolate-acuminate), *small, usually about* $\frac{1}{4}$ *line in length*, rarely $\frac{1}{2}$ line, *tapering to a fine acumen of very varying length*, narrowed and slightly decurrent at base, *entire or faintly denticulate, nerve usually rather faint and indistinct, reaching half-way or rather more, sometimes to the base of the acumen;* cells hexagonal-rhomboid, irregular, rather variable in size and in relative length, 3–6 times as long as broad, chlorophyllose or pellucid, broader and sub-rectangular towards base; marginal cells near basal angles *short, sub-quadrate or transversely shortly rectangular*. Seta slender, red, $\frac{1}{2}$ to nearly 1 inch long; capsule cylindric, strongly curved, constricted below the wide mouth when empty; lid conical, somewhat obtusely apiculate; calyptra whitish; peristome large. *Autoicous*. Spores 10–14 μ.

Var. β. *salinum* Carr., Gleanings among the Irish Cryptogams, p. 14, 1863 (var. *depauperatum* Boul., Braithw. Br. M. Fl.; *A. perminimum* Stirt. in Ann. Scot. Nat. Hist. xvii, 175). *Exceedingly slender*, yellowish, leaves rather distant, *extremely minute, nerve often very faint and short;* capsule less curved, frequently sub-erect.

Hab. On the ground, stones, decaying wood, etc.; abundant. The var. *salinum* chiefly on sandy sea coasts, rare. Fr. spring.

A. serpens varies much, and is often difficult to separate from the allied British species, though not so much so as from several closely related plants that occur on the continent. From most of our mosses it is known at sight by the very slender delicate plants of a dull green, usually fruiting abundantly, and then strongly characterised by the red setae tipped with small, white calyptras. From *Eurhynchium pumilum* it differs in the much more finely acuminate leaves with short wide cells; *Hypnum hispidulum* var. *Sommerfeltii*, which has a superficial resemblance to it, has much narrower areolation and the leaves strongly divergent or squarrose when dry. From the two preceding species it is usually known, even in its most slender forms, by the single nerve. It is much more difficult to separate from *A. varium* Lindb., some forms very closely resembling that species, but the nerve is perhaps

in *A. serpens*, never quite so distinct and prolonged, and the areolation is usually less firm and more pointed, besides which *A. varium* is perhaps constantly a larger plant than *A. serpens*, with a laxer habit, larger leaves, and wider, more regular cells.

A large number of varieties have been described, but most of them appear to be of little importance as regards stability, and rather to be considered as forms.

The var. β is a very attenuated form, comparable to the var. *trichodes* of *A. filicinum*, and sometimes scarcely separable from it but by the fainter nerve, which in the present plant is at times scarcely visible in some leaves. When growing inland as it sometimes does (var. *depauperatum* Boul.) it is slightly different in areolation from the sea-coast plant, but I think it is scarcely desirable to keep separate the two varieties which agree so closely in most important characters, and I have followed Braithwaite in uniting them. Carrington's name was however published in the Trans. of the Bot. Soc. of Edinburgh, and also in a reprint, and should be retained, whether or not Boulay's variety is united with it. *A. salinum* Bryhn is quite a different plant.

The var. *angustifolium* Limpr. (*A. angustifolium* Har. Lindb.) is one of the most marked of the other varieties, with very longly and finely acuminate leaves, a longer, thin nerve, and narrow, elongated cells. I have seen it from one or two English localities.

* **Amblystegium Juratzkanum** Schp. (*A. Juratzkae* Schp., Braithw. Br. M. Fl.) (Tab. LVI. J.).

A very variable plant, ranging in size and habit from *A. serpens* to *A. Kochii*; most nearly allied to the former, but more robust, usually deep green. Stem-leaves larger, widely spreading both wet and dry, quickly narrowed from a wide ovate base to a long slender acumen of about the same length. Margin minutely denticulate. Nerve stronger, often orange, usually reaching *above half-way*. Cells all larger and more pellucid, thin-walled or moderately incrassate, 8–11 μ wide, at margin towards base *rectangular, 1½–2 times as long as wide*. Branch-leaves narrower, spreading when moist and dry, but less constantly so than the stem leaves. Fruiting characters scarcely distinct from those of *A. serpens*.

HAB. Damp meadows, roots of trees and walls near water, etc. Recently detected in numerous localities in England, Scotland, and Ireland, and probably not rare. Fr. spring.

In its best developed forms a miniature of *A. Kochii*, but on the other hand at times scarcely separable from *A. serpens*, with which it undoubtedly intergrades. The long-pointed spreading leaves, at times almost squarrose, will as a rule separate it from that species, taken altogether with the laxer, usually more pellucid cells and stronger nerve; in critical cases the form of the basal marginal cells, elongated in *A. Juratzkanum*, but in *A. serpens* as wide as or wider than long, may be looked upon as a fairly good test, albeit a somewhat arbitrary one. *A. Juratzkanum* in fact embraces a number of somewhat nondescript forms upon which further light is desirable. The longer pointed leaves will generally distinguish it from very small forms of *A. Kochii*, which has also rather laxer basal areolation and the leaves generally more chlorophyllose. The two plants are however at times almost inseparable.

5. Amblystegium Kochii B. & S. (*A. trichopodium* var. *Kochii* Lindb., Braithw. Br. M. Fl.) (Tab. LVI. K.).

Stem prostrate, with erect or ascending branches, varying in size, some extremely slender, pale or deep green; the larger forms resembling *Hypnum riparium*, the smaller *A. Juratzkanum*. Leaves usually somewhat distant, *widely spreading in all directions from the base, or almost squarrose, cordate-ovate from a rather narrow, not decurrent base*, gradually tapering to a finely subulate-acuminate point, $\frac{3}{4}$ *line long, sinuolate or faintly denticulate at margin*, nerved about $\frac{3}{4}$ the length of the leaf; cells chlorophyllose, *rhomboid-hexagonal, widely pointed or truncate and obtuse, 4–6 times as long as wide*, gradually becoming wider towards base, at angles rectangular, lax, pellucid, but not forming distinct auricles. Seta rather long, 1–$1\frac{3}{4}$ inches, flexuose; capsule rather small, arcuate. Autoicous.

HAB. Marshy meadows, sides of pools, etc., rare; recorded from several English counties. Fr. summer.

This plant is usually considered very closely allied to *Hypnum riparium*, and is indeed made a sub-species of that moss by Boulay; but if areolation is to count for anything there can be no question as to the distinctness of the two plants; a glance at the very clear and representative drawings of the cells in the two species on Tab. LVI, or even at the figures given by Husnot (*Muscologia Gallica*, Tab. 204), one of the authors by whom it is considered closely allied to *H. riparium*, shows at once the wide difference, not only in size and width, but in character, between the cells of typical *H. riparium* and those of the present species; and though certain small forms, usually barren, of the former may approach the present in the width and shortness of the cells, they are very rarely found quite similar to those of our plant; and even when this is the case they can only be looked upon as exceptional.

The present species is on the whole more likely to be passed over for *A. varium*, but the shorter nerve, and larger, thinner-walled cells will clearly distinguish it from that species.

In its slender forms it approaches *A. Juratzkanum*, and I have sometimes found it scarcely possible to differentiate the two; it is however normally a much larger plant, with larger leaves and cells, the latter especially laxer at the base, and with the walls more constantly thin.

A robust form occurs with sub-pinnate stems and numerous paraphyllia.

6. Amblystegium varium Lindb. (*Leskea varia* Hedw.; *A. radicale* B. & S. et mult. auct., *non H. radicale* P. Beauv.) (Tab. LVI. L.).

Larger than *A. serpens*, in usually more straggling tufts, of a brighter green. Leaves *larger, about* $\frac{1}{2}$ *line in length*, more spreading both when moist and when dry, widely ovate-acuminate, tapering to a long fine acumen, *entire or sinuolate at margin*, narrowed at base and somewhat decurrent; nerve *strong*, green or brownish, *reaching nearly to apex and usually remaining distinct high up into the acumen*, rarely vanishing half-way up the acumen, or shorter; areolation *firm, rather*

large, distinct; hexagonal-rhomboid, 3–4 times as long as broad, usually less acute than in *A. serpens*, and relatively wider, more regular, *more incrassate;* larger towards base and shortly rectangular, rather incrassate, not forming distinct auricles. Branch-leaves narrower, ovate-lanceolate. Seta long, often 1 inch or rather more; lid conical, rather acutely pointed. *Autoicous.* Spores 15–20 μ.

HAB. On the ground, stumps of trees, etc., in moist situations; not common. Fr. spring.

Cardot has shown that there are good grounds for referring *H. radicale* P. Beauv. to *Ambl. hygrophilum* Schp., a very different moss in areolation, etc., and not yet known in Britain. In my opinion the British plants recorded as *A. radicale* (P. Beauv.) all belong to the present species; Mitten's plant from Hurstpierpoint, and Barnes' from Milnthorpe, have the strong orange nerve continued high up into the apex, and are certainly *A. varium*. I have indeed seen plants with the nerve ceasing at or below the base of the acumen while in all other respects entirely similar to *A. varium*, but they are extremely rare, and are to be looked upon as mere forms od the present plant. *A. varium* as its name implies is a polymorphous species, and one scarcely to be identified without microscopical examination. It is larger than *A. serpens* and only approached by the more robust forms of that plant; it is usually found in rather loose untidy tufts, and has possibly been somewhat overlooked in this country; on the other hand plants so named frequently turn out to be only large forms of *A. serpens*. It would appear to be less abundantly fertile than that species. From *A. irriguum* its robust forms differ in the much thinner, less solid nerve, the more narrowly tapering leaves, etc.

7. **Amblystegium irriguum** B. & S. (*Hypnum irriguum* Hook. & Wils.) (Tab. LVII. A.).

Stems prostrate, with the divisions more or less pinnate, but irregularly so, branches rather short, ascending or procumbent, slender, forming intricate tufts of *a deep olive green*, the young shoots brighter; stems tough, with few or no paraphyllia, denuded at the base. Leaves on the stems ovate, gradually and rather longly acuminate, *the point narrow and acute, but not slender and rather rigid;* at base somewhat narrowed and slightly decurrent; branch-leaves narrower, ovate-lanceolate or oblong-lanceolate; all *rather solid in texture and rigid*, erecto-patent or more frequently somewhat falcato-secund; margin plane, *sinuolate or obsoletely denticulate, rarely if ever quite entire;* nerve *very thick and wide*, brownish, *becoming narrower and somewhat indistinct high up in the acumen*, but *usually reaching to or nearly to the apex*, occasionally excurrent. Cells hexagonal-rhomboid, obtuse or slightly pointed, 4–6 times as long as broad, *incrassate, rather opaque*, somewhat narrower in the acumen; at base becoming gradually wider, irregularly rectangular or quadrate, usually opaque, occupying the whole base of the leaf and decurrent angles, a few at extreme base often enlarged, with thick orange walls, but not forming clearly marked auricles.

Seta rather long, firm ; capsule strongly arcuate, sub-cylindric, contracted below the wide mouth when empty. *Autoicous.*

Hab. Stones in streams, principally on siliceous formations, rather rare. Fr. summer.

The stout nerve and solid, rather rigid leaves easily separate this and the two following species from the allied plants ; *A. varium* is of much softer texture, with thinner, more flaccid leaves, and narrower, though distinct nerve ; its leaves are more usually entire, more ovate, with a more rapidly narrowing finer acumen ; in the present plant the leaves are more ovate-oblong in outline, more gradually tapering. *A. fluviatile* differs in the still stouter nerve, especially at apex, the less narrowly acuminate, often sub-obtuse leaves, and the entire margin ; and the capsule is narrower and less arcuate. The differences between *A. filicinum* and the present species are, in some forms of that plant, less marked ; as a rule it is a less aquatic plant than the present species, more rigidly pinnate, with the stem often densely tomentose, and with numerous paraphyllia ; more or less aquatic forms however approach very closely to the present moss, and are sometimes difficult to separate ; they prevail however in calcareous districts, where this species is rare ; the branching is usually more regularly pinnate, and the leaves more cordate-triangular and dilated at base, often more distinctly serrulate ; the most important characters are however the paraphyllia of *A. filicinum*, usually more or less numerous both on stem and branches even in the more aquatic forms, and the basal angular cells, which in that plant are always more or less hyaline and thin-walled, and clearly marked off from the other basal cells. In the present plant the leaves are firmly attached to the stem, and when detached often leave the decurrent angles remaining adherent to the stem but even when these are removed with the leaf they are hardly distinct from the other basal cells, and are incrassate, comparatively small, and usually dark and opaque, never hyaline and thin-walled. As regards the var. *spinifolium* Schp., the student is referred to the note on *A. filicinum*.

A. irriguum is not unfrequently submerged and floating, with elongated stems.

8. Amblystegium fluviatile B. & S. (*Hypnum fluviatile* Swartz) (Tab. LVII. B.).

Allied to the preceding species ; more robust, with longer, almost simple divisions of the stem, with *few, hardly pinnate, parallel branches*, in *softer*, more floating and elongated tufts, *deep green, often blackish*. Leaves less spreading, *more erect when dry*, and often, in the more dense-leaved forms, somewhat spirally imbricated ; larger, but of somewhat narrower outline, *oval-oblong or oblong-lanceolate*, not dilated at the base, and less distinctly decurrent ; much more gradually tapering to *a much shorter, wider point, muticous or almost obtuse, not narrow nor acute ;* margin *quite entire or very faintly sinuolate ;* nerve *very stout and thick, hardly narrowing in the point, and usually reaching distinctly to the apex*, though often becoming confused with the somewhat obscure apical areolation. Cells as in the last, or slightly larger and less opaque ; at base rather more distinctly rectangular, pellucid or opaque, often orange, strongly incrassate,

not forming distinct auricles. Capsule *longer, narrowly cylindrical*, sub-erect, slightly, not strongly arcuate, much constricted below the mouth, often more strongly in front so that the mouth is incurved, darker in colour and of thicker texture. *Autoicous.*

HAB. Stones in mountain streams; rather rare. Fr. summer.

A. fluviatile is in general easily known from the preceding species by the characters italicised above and pointed out under that plant; the difference in the leaves will perhaps be best realised by a comparison of the figures. According to Boulay, Husnot, etc., intermediate forms are frequently found, and the former author even considers it a sub-species of *A. irriguum*. I have not been able to find any constant differences in areolation, such as are sometimes described, between the two, and the less rigid texture ascribed to *A. fluviatile*, though usual, does not appear to be a constant character; on the other hand the characters derived from the leaf-form and nerve are well marked in very nearly all the British specimens I have examined, and in all probability the intermediate forms mentioned above are practically confined to continental Europe; the student will not, I believe, find any great difficulty in regard to our British plants.

The present species is usually found in more rapid streams than the last, and is more distinctly aquatic; much of the difference in its habit and branching is doubtless owing to this fact. It frequently occurs in but is not confined to calcareous localities.

9. Amblystegium filicinum De Not. (*Hypnum filicinum* L., Schp. Syn. et plur. auct.) (Tab. LVII. C.).

Very variable in habit, the stems typically erect or ascending, rigid, divided, *somewhat regularly but not complanately pinnate;* forming loose or dense rather rigid tufts of *a bright or golden green colour*. Stems usually *densely tomentose with brown radicles* for the greater part of their length, especially in the prostrate and procumbent forms, with *more or less numerous multiform paraphyllia* (oval, lanceolate or laciniate) among the leaves; branches slender, short, rigid and brittle, sometimes hooked at the tips by the strongly falcate leaves, frequently with paraphyllia but not radiculose. Stem-leaves *cordate-triangular, gradually and finely acuminate*, erecto-patent or slightly secund; branch-leaves rather narrower, *more frequently falcato-secund*, often strongly and regularly so and especially falcate at the tips of the branches, rendering them hooked; all *rigid and little altered when dry*, not or faintly plicate, *strongly decurrent* at the narrowed, cordate base, plane at margin or recurved at the base, *finely and closely serrulate throughout;* nerve *strong*, usually yellowish, narrowing above and reaching apex or slightly excurrent or lost in the acumen. Cells resembling those of the last two species but less incrassate and more variable, elliptic-hexagonal or sometimes linear-rectangular, obtuse at ends and more rounded, less angular, rather smaller, shorter, 3–5 times as long as broad; gradually becoming wider and sub-rectangular towards basal

angles, then *suddenly dilated, hyaline or sometimes orange-brown*, sub-rectangular, usually thin-walled, *forming clearly marked, decurrent auricles* reaching nearly to the nerve. Perichaetial bracts numerous, denticulate, hardly plicate, strongly nerved. Seta long, 1¼–2 inches; capsule sub-cylindrical, rather turgid, arcuate; lid conical, apiculate. *Dioicous.*

Var. β. *vallisclausae* (*Hypnum vallisclausae* Brid., *sensu* Boul. et mult. auct., *non* Husnot; *Hypnum Formianum* Schp., Syn.? *A. fallax* Milde, Braithw. Br. M. Fl.). Stems hardly radiculose, denuded at base, covered with the bristle-like nerves of the older leaves, less regularly pinnate, with fewer, longer branches; leaves more erect when dry, less strongly and often not at all falcato-secund; nerve *very thick and strong, excurrent* in a strong, acute point of varying length; areolation firm, rather narrow. *Paraphyllia few. Aquatic.*

Var. γ. *trichodes* Brid. *Very slender, prostrate*, deep green, or golden; irregularly branched; leaves *very small.*

Var. δ. *Whiteheadii* Wheldon (*Journ. of Bot.* 1899, p. 15.) Dull yellowish green; stems *erect*, slender, with few *not pinnate divisions*, which are *almost simple* or with a very few short branches, scarcely or not tomentose. Leaves distant, *imbricated all round, rigid and divergent, not at all secund or falcate.*

HAB. Damp ground, stones and rocks near streams, bogs, etc., principally in calcareous districts. Common. The var. β rare, in calcareous springs; the var. γ rare. The var. δ on sandy ground in several localities in Lancashire (*Wheldon*); Merioneth (*Jones*); Gullane Links, Haddingtonshire (*Dixon*). Fr. spring, but not common.

A very variable, almost protean plant, yet with a distinct habit and leaf-structure which make it as a rule easy to recognise, although it is extremely difficult to classify the various forms, many others of which might be enumerated in addition to the above. I have no authentic specimens of the var. *gracilescens* Schp., which is recorded in the Lond. Cat. of Brit. Mosses from Yorkshire, but it is probably to be united with the var. *trichodes* (*H. trichodes* Brid.), and includes the very slender, prostrate, small-leaved forms, some of which are so slender as to bear a close resemblance to *A. serpens*. I have however thought it more correct to employ the name *trichodes* (rather than Schimper's name as in the first edition of this work), partly as the earlier name, partly as representing the more extreme forms and those therefore most deserving of rank. From *Hypnum commutatum*, *A. filicinum* differs in the narrower, more rigid and scariose leaves, not crisped when dry, nor deeply plicate, never circinate nor perhaps ever so strongly falcate as to form a half circle, and especially in the very different, wide, sub-hexagonal areolation. The differences between the present plant and *A. irriguum* have been dealt with under that plant, but some remarks are necessary with regard to the var. *vallisclausae*. Much has been written and very different opinions are held with regard to the true place of this plant, some authors maintaining it as a species, others referring it to one or other of the two species in question; it appears clear that both *A. irriguum* and *A. filicinum* give rise to analogous forms, which are hardly distinguishable, but may probably be always separated by the basal areolation and form of the leaves; the latter in *A. irriguum* var. *spinifolium* being narrower, ovate-lanceolate only on the stems, lanceolate

on the branches; while the stem-leaves of *A. filicinum* are cordate-ovate at base, and the branch-leaves ovate or oblong-lanceolate, with the auricles more or less clearly defined and inflated, which is not the case in *A. irriguum*. *Hypnum falcatum* var. *virescens* is a form similarly related to *H. falcatum*; it is readily known by the longer, narrower areolation.

The already complicated nomenclature of the present variety has been rendered still more involved by the transference of the name *vallisclausae* by Husnot to the analogous forms of *A. irriguum* (including var. *spinifolium* Schp.), that author holding that Bridel's name referred to a form of the latter species, not to *A. filicinum*. In the absence of clear proof I have thought it best to retain the more usual application of Bridel's name to the variety of the present species.

Nearly all the British plants I have examined of these forms belong distinctly to *A. filicinum*, and are therefore to be referred to its var. *vallisclausae*; but I have seen the analogous variety of *A. irriguum* from Scotland.

The basal auricles in *A. filicinum* are sometimes exceedingly distinct, but occasionally are less marked and with rather incrassate walls; the leaves are, however, almost always more deltoid at the base than in *A. irriguum*, and the angular cells are probably always, even in the above cases, much more strongly marked; the inflorescence is also an important distinguishing character. The fruit is rare in the present species.

A very slender form with narrow leaves occurs which is easily mistaken for *Hyp. elodes*.

The var. *Whiteheadii* is a very distinct form in the almost simple stems and the spreading, not secund leaves. Renauld has gathered it in France, and had indeed described it as a new variety in MS., but the description remained unpublished.

10. Amblystegium curvicaule Lindb. (as sub-spec.) (*Hypnum curvicaule* Juratz., Schp. Syn.) (Tab. LVII. D.).

Stems creeping or ascending, *hardly radiculose*, divided, 1–2 inches long; the divisions sub-simple or more or less regularly pinnate, flexuose; branches slender, rather obtuse, or acute, *usually curved at the tips*; forming low tufts of a green or golden colour, yellowish internally, rather soft. Leaves *erecto-patent*, when dry erect, loosely imbricated, often sub-secund, at apex of branches here and there falcate, *cordate-triangular or widely cordate-ovate, short, ½ line in length*, narrowed above, then *rapidly, almost suddenly acuminate in a short slender point*, decurrent at base, concave, sometimes slightly plicate, of rather soft texture; margin plane, minutely denticulate; nerve strong, *reaching to the acumen and there becoming indistinct and vanishing*; cells resembling those of *A. filicinum*, but *narrower*, elliptic-hexagonal or elliptic-linear, *usually 3–6 times as long as broad*, pellucid, the walls firm and somewhat incrassate; laxer at base; at basal angles suddenly dilated, *hyaline or orange, large, rectangular, forming wide, decurrent auricles. Paraphyllia none.* Fruit unknown.

Var. *β. strictum* Dixon, Handb. Ed. I. Stems and branches *prostrate, rigid*, elongated, 2–4 inches long, *much denuded except at the tips*; branches *straight, not or scarcely curved, acute and*

cuspidate at apex; leaves sub-scariose, glossy, not plicate, *rigid, oblong-lanceolate, or narrowly ovate-lanceolate;* areolation *narrower,* elliptic-hexagonal or linear-rhomboid, *6–8 times as long as wide,* very suddenly dilated at decurrent angles, large, inflated, bright orange in the older leaves. Tufts deep orange-brown, dark brown below.

HAB. Wet rocks, Ben Lawers, alt. 3,500ft., 1893 (*Dixon*). The var. *strictum* with the type.

This moss, which has been very perplexing to systematists, was gathered by me near the summit of Ben Lawers in the summer of 1893, and by a curious coincidence was gathered on the same mountain, independently, by the Rev. H. G. Jameson, very shortly afterwards, and has since been found there by several collectors. Mr. Jameson's specimens appear to belong to the type, agreeing exactly, as do some of mine, with the specimens from le Sentis, Switzerland, published in the Musci Galliae, No. 786, by Culmann, and also with Breidler's from the Tyrol, as well as with Juratzka's original description, given in the very lucid article on this species by Venturi in *Rev. Bry.*, 1881, p. 82. The greater part of my specimens, however, while incontestably belonging to the species in question, are so different in habit, texture, leaf-form, and areolation that I have thought them fully deserving a varietal name; the cells are of the same character precisely, but longer and narrower, rarely less than six times as long as broad, while in the type they rarely attain this proportion; the leaves are much narrower, from twice to three times as long as broad, while in the type they range from once and a half to twice as long as wide, rarely exceeding the latter proportion. The habit, too, is much more rigid and very different.

The affinities of this plant are very doubtful; the general consensus of opinion places it near *A. filicinum*, although various authors have placed it in the sections Harpidium, Limnobium, and Calliergon of the genus Hypnum; Lindberg indeed makes it a sub-species of *A. filicinum*, which may be a correct view, but the very different appearance, the absence of paraphyllia, the characteristic acumination of the leaves, and the very different nerve remove it from all forms of that very polymorphous plant. The nerve, though comparatively strong, is much less so than in *A. filicinum* and always ceases almost or quite at the base of the acumen; the acumen itself is very abrupt and markedly different from the gradual acumination of *A. filicinum* and most of the allied plants; it forms, indeed, such a constant and marked character that Venturi is probably right in thinking that Schimper's description of the leaves as gradually acuminate points to a different plant, specimens of a Harpidioid Hypnum having frequently been mixed with and labelled as the present species. It is probable that no definite agreement will be arrived at until the fruit is found.

A. curvicaule may be readily known by the more or less abrupt acumen, long nerve and short areolation with abruptly dilated hyaline auricular cells, from the other species of the genus, and indeed from all our other pleurocarpous mosses. It is a high alpine species, and is not likely to be found elsewhere in our islands unless in similar localities on the highest Scotch mountains.

114. **HYPNUM** L. (emend. B. & S.).

Plants of various habit and branching, often robust, *very frequently more or less regularly pinnate*. Leaves variable, usually *more or less scariose in texture, with linear areolation, rarely less than 5 times as long as wide and usually much longer, often vermicular, not papillose ;* usually forming distinct auricles at basal angles ; leaves often falcate or circinate ; nerve usually none or double, more rarely simple. Seta *smooth*, capsule curved, inclined, very rarely erect or sub-erect, usually sub-cylindric, or shorter and small ; lid conical, obtuse or acuminate, *not longly rostrate*. Peristome *perfect*.

The members of this genus are distinguished from Amblystegium by the longer, narrower cells ; from Plagiothecium by the areolation and non-complanate leaves (only one or two British species having them secund and homomallous as in *P. pulchellum*), from Eurhynchium by the non-rostrate beak, etc. ; from Brachythecium by the usually sub-cylindrical, narrower capsule, the linear, rarely rhomboid areolation, and the nerve rarely single ; but as in other cases, individual plants, especially when barren, can often only be referred to the right genus by experience. The student, however, will do well to bear in mind that no species with longly acute or acuminate leaves and well-defined single nerve belong to this genus except those of the Sections Harpidium (easily known by the strongly falcate leaves), and two or three species of the Section Campylium.

DERIV.—ὕπνον (hŭpnon), a Greek word for a moss or some other Cryptogamic plant.

In classifying the species of this large genus I have for the most part followed the system employed by Schimper in the Synopsis. It is, however, I think, generally felt that the sub-divisions there are unnecessarily numerous, and I have in one or two cases merged two of his sub-genera into one. Thus under Harpidium (Drepanocladus (C. M.) Roth, of recent authors) I have included all the falcate-leaved species with elongated single nerve and with the angular cells usually dilated, irrespective of the thickness of the nerve ; *i.e.*, I have included the sub-genus Cratoneuron of Schimper ; the nerve in some of the true Harpidium species being equally strong, while in *H. sulcatum* it is very feeble ; and the presence of paraphyllia and radicular tomentum being equally inconstant. I have also eliminated the sub-genera Ctenidium and Ctenium, placing the two species there included by Schimper, *viz.*, *H. molluscum* and *H. cristacastrensis*, under Drepanium, from which they are hardly separable by any important structural detail ; and I have done the same with *H. incurvatum*, our only British representative of the sub-genus Homomallium. Scorpidium (*H. scorpioides*) will be found united with Limnobium, and *H.* (Rhytidium) *rugosum* placed

(following Lindberg) with Hylocomium. I venture to think that by so doing an equally sound basis of classification is arrived at, while the characters on which the Sections, or sub-genera, are based are much more clearly defined and consequently much more easily employed by the student.

A. CAMPYLIUM. Leaves *more or less longly acuminate*, usually *squarrose-divergent both wet and dry* or rarely secund, *never strongly falcate nor circinate;* branching irregular or sub-pinnate; nerve single, varying in length, or none, rarely double; cells narrow-linear. Plants often small. Paraphyllia none.

B. HARPIDIUM. Plants usually tall and robust, often erect, more or less pinnately branched. Leaves *falcato-secund or circinate, longly and gradually acuminate, with a single nerve reaching above half-way and often nearly or quite to the apex;* cells linear, often very long and vermicular, usually much dilated at angles; paraphyllia often present. Leaves mostly large. Plants *more or less aquatic.*

C. DREPANIUM. Plants prostrate or ascending, *more or less regularly pinnate.* Leaves usually small, *strongly falcate or circinate,* rarely almost straight but strongly homomallous, *nerveless or with two faint nerves, longly and acutely acuminate.* Plants *rarely aquatic.* Paraphyllia few or none, rarely abundant.

D. LIMNOBIUM. Usually procumbent or ascending, of *soft, flaccid texture,* variously branched. Leaves *usually secund but not strongly falcate, wide, obtuse or apiculate,* rarely tapering to a short point, *never finely and longly acuminate;* nerve double or none, very rarely single. More or less aquatic, on wet rocks.

E. CALLIERGON. Plants erect or procumbent, usually slightly branched only, or sub-pinnate. Leaves *imbricated all round, rarely secund,* usually large, *broad, obtuse or only apiculate,* nerve single or double. Terrestrial or bog plants, tall and often robust.

1 { Leaves sharply acuminate, acumen often long and narrow....2
  { Leaves very shortly pointed, or obtuse or apiculate, or with short, bluntish acumen....5

2 { Nerve single....3
  { Leaves nerveless, or shortly 2-nerved....4

3 { Leaves squarrose or spreading (rarely more or less secund) ....*A. Campylium*
  { Leaves falcato-secund or circinate....*B. Harpidium*

4 { Leaves squarrose-divergent....*A. Campylium*
  { Leaves secund, falcate, or circinate....*C. Drepanium*

5 { Ls. wide, soft, flaccid, usually secund; on wet rocks, etc. *D. Limnobium*
  { Ls. firm, patent or imbricate; usually in bogs or on the ground *E. Calliergon*

A. CAMPYLIUM.

Leaves more or less ovate-acuminate, acutely pointed, divergent or squarrose when dry, or secund, not strongly falcate.

[The only species in this Section which have the leaves more or less erecto-patent or secund, not squarrose, viz., *H. riparium* and *H. polygamum*, always have a long, single nerve].

1 { Leaves single-nerved 2
  { Nerve absent, or short and double 5

2 { Ls. narrowed above to a long, very narrow acumen ; plant slender 3
  { Ls. more gradually tapering to a wider acumen ; plant larger 4

3 { Nerve running up far into the acumen ..... *2. elodes*
  { Nerve ceasing about half-way up leaf ..... *4*. chrysophyllum*

4 { Ls. distinctly auricled with enlarged cells at angles ..... *3. polygamum*
  { Basal cells enlarged, but not forming distinct auricles ..... *1. riparium*

5 { Ls. sharply serrulate, all strongly recurved ..... *6. Halleri*
  { Ls. almost entire above, less recurved 6

6 { Stem creeping, slender ; angular cells of ls. small, quadrate ..... *5. hispidulum* var.
  { Stem usually erect ; angular cells dilated ..... *4. stellatum*

1. Hypnum riparium L. (*Amblystegium riparium* B. & S., Braithw. Br. M. Fl., Schp. Syn. et mult. auct.) (Tab. LVII. E.).

Very variable in size and habit ; typically low, creeping, sub-pinnate with short, spreading branches ; *bright or yellowish green*, 2–3 inches long ; leaves *long, 1–2 lines* (occasionally smaller) *widely spreading or almost squarrose both wet and dry, often sub-complanate*, rarely erecto-patent, but often forming a cuspidate tuft and secund at the tips of the branches ; *silky ;* more or less *widely ovate-lanceolate or oblong-lanceolate*, longly and gradually tapering to a fine, *flat, not channelled* acumen, rounded at base to a narrow, shortly decurrent insertion. Margin plane, *entire ;* nerve strong at base, *reaching above the middle and usually ¾ the length of the leaf ;* cells *linear-rhomboid, acute, 10–15 times as long as broad*, thin-walled, chlorophyllose ; *becoming lax at some distance above the base, gradually towards angles larger, rectangular and often pellucid, but not forming distinct nor hyaline auricles.* Seta ½–1 inch long ; capsule oblong-cylindric, somewhat turgid, strongly curved ; peristome large. *Autoicous.*

Var. *β. longifolium* Schp. Leaves *narrow*, lanceolate-acuminate, *with a very long and tapering, almost filiform acumen ; rather distant.* Stems with almost simple, *hardly branched* divisions *usually sub-complanate.*

Var. *γ. splendens* De Not. Resembling var. *longifolium* in habit but with *very large, broad leaves, less finely acuminate, more crowded*, very regularly imbricated.

HAB. Roots of trees, stones, etc., near water. Common in the lowlands, rare in mountainous parts. The vars. β and γ floating, in pools, etc., less common. Fruit at all times of the year.

A very variable plant, but usually known by the longly-pointed, entire leaves, widely divergent and straight when dry, with a long stout nerve and linear, pointed areolation; in the latter character it is typically very different from all the species of Amblystegium, with which it is usually united; while the single-nerved, entire, not plicate leaves will at once distinguish it from any of the species of the previously described genera to which it may bear any resemblance. It is sometimes much more like *H. aduncum* (Group *Kneiffii*), but only in a few very extreme forms; it is then scarcely to be identified but by the areolation gradually becoming laxer at the base of the leaves, not suddenly enlarged at the angles. The larger, wider, chlorophyllose leaves, often complanate, and though widely spreading, hardly squarrose will separate it from the other species of this Section except *H. polygamum*, the basal areolation of which is quite different, and the acumen channelled.

The var. *splendens* is a very handsome plant, with wide flat branches having the large leaves very regularly arranged and of a deep green. This variety and the var. *longifolium* are often very much elongated, 6 or 8 inches long, and almost with the habit of Fontinalis.

The union of this species with those of the Section Campylium may without doubt give rise to some questioning. On the one hand the areolation is frequently shorter than in the type, approaching that of *Amblystegium Kochii*; but this is exceptional, and is never the case in the more ordinary and by far the greatest number of forms, nor, as far as I am aware, in fruiting plants, and can of itself be held no more a ground for uniting the species with Amblystegium than can the fact that in other forms it nearly approaches *H. aduncum* be held a reason for placing it in Harpidium. In all the more ordinary forms the outline and the direction of the leaves give it full as much a title to a place here as *H. polygamum* and *H. elodes*. On the whole I think it must be conceded that its affinities with the plants of this Section are at least as close as with Amblystegium, in which genus it is in its typical form decidedly anomalous.

2. **Hypnum elodes** Spruce (*Amblystegium elodes* Lindb., Braithw. Br. M. Fl.) (Tab. LVII. F.).

Very slender; stems 2–4 inches long, procumbent, irregularly pinnate, branches slender, ascending; in large low tufts, olive green or yellowish. Stem-leaves *distant, widely spreading;* branch-leaves somewhat closer, but not densely placed, slightly secund at the tips of the branches; all *very small, $\frac{1}{4}$–$\frac{3}{4}$ line long, narrowly ovate-lanceolate or lanceolate,* widest just above the base, gradually tapering to a long fine acumen, hardly decurrent, narrowed at base; margin plane, *obsoletely denticulate;* nerve yellowish, *strong, vanishing in the acumen.* Cells widely linear, thin-walled, 8–12 times as long as broad, at base larger, shorter, sub-rectangular, more incrassate, covering a large space at the base of the leaf, but *not forming well-defined auricles.* Seta long, 1–2 inches; capsule sub-cylindric, curved. *Dioicous.*

HAB. Marshy meadows, on earth by water, etc., rare. Fr. spring, very rare.

A delicate plant, resembling *H. chrysophyllum*, but quite different in the long, strong nerve, and by that and the divaricate, narrower, distant, denticulate leaves readily identified. *H. polygamum* is a larger plant with fainter, shorter nerve, quite entire margin, and more distinct angular cells, and the inflorescence autoicous.

Small forms of *Amblystegium Juratzkanum* are known by the shorter nerve and wider cells, and slender varieties of *A. filicinum* which may very closely resemble it, by the shorter, wider areolation.

The var. *hamulosum* Schp., a form with falcate leaves, occurs with us.

3. Hypnum polygamum Schp. (*Amblystegium polygamum* B. & S., Braithw. Br. M. Fl.) (Tab. LVII. G.).

Resembling *H. stellatum;* moderately robust, less erect; yellowish green or golden. Leaves not very densely crowded, *erecto-patent both moist and dry, not or very rarely squarrose*, often sub-secund, *longly and widely lanceolate*, gradually tapering to a long, *channelled* acumen, entire, from a rather narrow, hardly excavate, *not cordate nor triangular base;* nerve *single, reaching half-way or more, distinct*, but not very strong; areolation narrow, linear, as in the firmer forms of *H. stellatum;* at basal angles distinct, large, often orange, forming distinct auricles usually reaching nearly to the nerve. Seta long, 1½–2 inches or even more; capsule variable in form. *Autoicous or synoicous.* Flowers numerous, often clustered.

Var. β. *stagnatum* Wils. *Larger and more robust.* Stems *more erect*, sub-pinnate, leaves *large.*

Var. γ. *minus* Schp. *Very small*, resembling *H. chrysophyllum;* leaves *squarrose or sub-squarrose*, acumen *less channelled;* nerve *shorter, often double*, variable. Seta short.

HAB. Marshes, wet meadows, etc., not common. The var. β rare; var. γ very rare. Fr. summer.

Not easy to recognise in the field from certain forms of *H. stellatum*, though very different from the typical form of that species in the less spreading, narrower leaves, and usually very fertile. The narrow base of the leaves, the long nerve, and different inflorescence will easily separate it under the microscope.

The typical squarrose leaves of *H. stellatum* will not flatten out under a cover-glass without the involution of the margins in the middle, or at least without rendering them undulated; in the present plant, and in typical *H. chrysophyllum*, the less squarrose direction allows of their being flattened without much alteration of outline.

Like *H. stellatum* it is sometimes very slender, with shorter, more spreading leaves. The var. *minus* is however more than a slender form, being distinct in the squarrose direction of the leaves and the less developed nerve. It is scarcely separable from some forms of *H. chrysophyllum* except by the inflorescence.

Wilson's var. *stagnatum* is the larger, robust form of this plant, stronger in all its parts than the more slender and commoner form.

The areolation will usually distinguish *H. polygamum* from *H. riparium*. I have however seen forms which could scarcely be recognised from that species except by the channelled acumen.

4. Hypnum stellatum Schreb. (*Amblystegium stellatum* Lindb., Braithw. Br. M. Fl.) (Tab. LVII. H.).

Very variable. Typically *robust*, stems stout, *erect or ascending*, 2–4 inches high, somewhat divided, and with numerous, sub-pinnate, more or less crowded and erect branches; forming large soft tufts of a *yellowish green or bright golden colour, glossy*. Leaves variable in size and form, $\frac{3}{4}$–$1\frac{1}{2}$ *lines long*, somewhat crowded, from an *erect, ovate or widely cordate base, more or less rapidly narrowed to a long, gradually tapering, acute, squarrose acumen*, hardly altered when dry, rigid, scariose, at base *wide*, slightly excavate, with rounded, hardly decurrent auricles, in the acumen somewhat channelled; *entire*, or sinuolate at base only; *nerveless or with a very short and faint, double or single, often forked nerve;* cells narrow, linear, in the young leaves often pointed and somewhat thin-walled, 8–10 times as long as wide, in older leaves often narrower and obtuse, with the walls incrassate and porose, almost uniform to base; at angles *distinct*, sub-rectangular, incrassate, variable in size and colour, opaque, orange or pellucid, *forming larger or smaller, more or less distinct auricles*. Seta long, 1–$1\frac{1}{2}$ inches, stout; capsule oblong-cylindric, curved. *Dioicous*.

Var. *β. protensum* Roehl (*Hypnum protensum* Brid., *Ambl. protensum* Lindb., Braithw. Br. M. Fl.). *Slender, more or less procumbent*, with *more regularly pinnate*, spreading branches, forming low, usually prostrate, often much elongated, creeping tufts; leaves *more distinct, smaller, more abruptly longly and finely acuminate from a distinct ovate-cordate base*, nerveless or with a very faint single nerve, reaching nearly halfway; angular cells usually fewer and smaller.

Hab. Bogs, marshy meadows, etc. Frequent. The var. *β* on wet calcareous rocks, beds of pools, etc., rarer. Fr. rare, summer.

In its typical form this is a robust, handsome species of erect, compact growth and rich golden colour; but it has a strong tendency to become slender, straggling, and untidy, of a dull dirty green. Some of the forms are very slender, and a number of varieties are described by Boulay, mostly tending in this direction and varying in leaf-form, etc.; I find the form of leaf so variable, however, even on the same plant, that I think it more satisfactory to include all the more slender, more or less prostrate forms with small leaves under the var. *protensum*, which in its extreme state is a very marked, pretty plant; very small forms of it approach *H. chrysophyllum* in habit and leaf, but it may perhaps always be distinguished by the more distant, more squarrose leaves, usually wider at base, and generally, though not always with larger auricular cells.

H. stellatum sometimes has much the appearance of *H. polygamum*, with less squarrose leaves of a narrow outline, but wanting the long distinct nerve of that species, and with a different inflorescence. A very faint single nerve however in the form of a slender stria or line, sometimes occurs in otherwise typical plants.

*** Hypnum chrysophyllum** Brid. (*Amblystegium chrysophyllum* Lindb., Braithw. Br. M. Fl.) (Tab. LVII. J

Differs from most forms of *H. stellatum* as follows: *much more slender*, stem prostrate, with sub-erect or spreading, pinnate branches, forming low, lax or denser tufts, *rarely an inch high, bright golden*, rarely yellowish green. Leaves *smaller*, ½–1 *line long*, more crowded, *less squarrose, frequently secund, narrower at base*, more gradually tapering, triangular-lanceolate or ovate-acuminate, nerve *slender, single, reaching half-way or slightly beyond;* cells as in *H. stellatum* but frequently shorter and wider, 5–10 times as long as broad; angular cells *usually smaller and more opaque*, less frequently dilated and pellucid.

Var. β. *erectum* Bagnall (*Journ. of Bot.*, 1896, p. 111). (*Amblystegium geophilum* Stirt. in Ann. Scot. Nat. Hist. xvii., 175). In *dense large tufts*, 1–2 inches high, *yellowish green*. Stems *erect or ascending with densely pinnate, erect, crowded branches;* leaves more regularly secund, *often distinctly falcato-secund*, sub-denticulate at basal margin.

HAB. On the ground, rocks, etc., in calcareous districts. Frequent. The var. β, England; N. Wales; Ireland. Fr. very rare, summer.

After examing a large number of specimens of this and *H. stellatum* I am compelled to think the difference between them is very slight indeed. It is quite impossible to found the distinction on the presence of the single elongated nerve; for undoubted plants of *H. stellatum* not unfrequently have a thin nerve reaching half-way up the leaf, while it is not uncommon in equally undoubted *H. chrysophyllum* to find leaves with hardly any trace of nerve. Beyond this, I have frequently examined plants which, while exactly agreeing in aspect with *H. chrysophyllum*, as well as in leaf-form and areolation, show in almost all the leaves the faintest traces of nerve, with occasionally a more pronounced one. The angular cells vary very greatly, and while as a rule in the large, wider leaves of *H. stellatum* they are large and pellucid, and in the small, narrower leaves of *H. chrysophyllum* small and opaque, every gradation can be observed between these two conditions. At the same time the forms of *H. stellatum* which constitute the connecting links are rare, and the student will seldom have any difficulty in recognising *H. chrysophyllum* from the delicate, silky habit, golden colour, nerved leaves and frequently shorter cells. It so closely resembles the most slender forms of *H. polygamum* that it is sometimes only separable by the inflorescence. Such forms are however very rare.

The var. *erectum* is a very marked form, with much the aspect of robust plants of *Plagiothecium pulchellum;* I have received exactly the same plant from the Rev. A. C. Waghorne, gathered in Newfoundland, and have gathered it myself in the Pyrenees.

A green, not yellowish form of the sub-species sometimes occurs, with shortly acuminate leaves and lax areolation.

5. Hypnum hispidulum Brid. **var. Sommerfeltii** (Myr.) (*H. polymorphum* Wils., *non* Hedw.; *Campylium hispidulum* var. *Sommerfeltii* Lindb., Braithw. Br. M. Fl.; *H. Sommerfeltii* Myr., Handb. Ed. I.) (Tab. LVII. I.).

Very slender, stems about 1 inch long, with numerous, sub-pinnate, slender, erect branches, forming small *dense* tufts of a

pale, rarely yellowish green. Leaves *rather closely set, spreading and squarrose,* sometimes secund at the tips of the branches; little altered when dry; *small,* about ½ line long, from a wide, cordate-oval base longly and finely acuminate, rounded at base to a rather broad insertion, *finely denticulate in the lower half, nerveless or with a very short and faint single or double nerve;* cells linear, somewhat vermicular, obtuse, 6–10 times as long as wide; almost uniform to base, at angles distinct, few, sub-quadrate, rather small, opaque, forming *small but rather well defined, yellowish or dark auricles.* Seta about ¾ inch long; capsule oblong-cylindrical, slightly turgid and gibbous, curved; lid conical, obtusely apiculate. *Autoicous.*

HAB. About the roots of trees, on stones, etc., on calcareous soil principally. Not common. Fr. summer.

This little plant has the habit and appearance of *Amblystegium serpens,* but is easily recognised by the squarrose leaves, of quite different structure. From *H. chrysophyllum* it differs in the distinctly denticulate leaf-base, autoicous inflorescence, etc.; from the other species, except *H. Halleri* which is quite distinct, in the small size and denticulate leaves.

It appears that our plant is not specifically distinct from *H. hispidulum* Brid., the type of which is a N. American and north European species, differing from our variety in the leaves wider at base, less finely acuminate, serrulate all round, and with rather shorter areolation, the angular cells less distinct and less highly coloured. Our plant must therefore take the rank of a variety under the older species.

6. Hypnum Halleri Linn. fil. (*Campylium Halleri* Lindb., Braithw. Br. M. Fl.) (Tab. LVII. K.).

Very slender, stems entirely prostrate, divided, 3–4 inches long, with numerous, pinnate, very short branches, erect or spreading, forming *very dense flat tufts, not half-an-inch high, rich golden brown or golden green, dark within.* Leaves *crowded, recurved-squarrose from a more erect base,* hardly altered when dry, widely or ovate-rounded with a *rather abrupt, short, acute acumen, minutely denticulate all round,* slightly recurved at basal margin, *nerveless or with a very faint, short, double nerve;* cells rather short, 6–10 times as long as wide, linear, obtuse; at angles few, sub-quadrate, not very conspicuous. Seta short, about ¾ inch; capsule *small,* ½ line long, more or less curved, constricted below the mouth, *reddish purple with a somewhat glaucous tinge,* especially when young. *Autoicous.*

HAB. Alpine rocks; very rare; Ben Lawers; Craig Chailleach; Ben Cruban; Ben Tigh. Fr. summer.

A very distinct and pretty little species, in very dense low patches, and at once characterised by the colour, and by the very squarrose, recurved leaves, which have much shorter points than in the allied species, and therefore give a quite different, more compact aspect to the stems and branches. On the continental mountains it is fairly common and fruits abundantly.

B. HARPIDIUM.

Leaves usually large, strongly falcate or circinate, rarely only slightly falcate; nerve single, reaching half-way, usually much higher, often strong. Bog plants, or growing in wet places on rocks.

[All the British pleurocarpous mosses with strongly falcate, acuminate leaves having a long single nerve belong here, with the exception of some forms of *Amblystegium filicinum* with strongly curved leaves, recognised at once by the short, wide, sub-hexagonal cells. *Hypnum palustre* and *H. ochraceum* never have the leaves finely and longly acuminate].

Hypnum capillifolium Warnst. should be looked for in our northern bogs. It is allied to *H. aduncum* and *H. Sendtneri*, but is strikingly distinct in its strong nerve, excurrent in a long subulate point. I have found it occurring among glacial or post-glacial deposits from Mundesley, Norfolk, and also from the Thames Valley.

In the following arrangement I have made great use of Renauld's elaborate monograph of the European Harpidioid Hypna in the Muscologia Gallica, although with some slight differences from that arrangement.

Since the publication of the first edition of this work our British forms have received considerable attention and comparison with the continental forms, thus demanding and, I think, justifying a somewhat fuller treatment. In "The North of England Harpidia," and "Key to the Harpidioid Hypna" (Naturalist, 1902 and 1921–2), Mr. J. A. Wheldon has embodied most of the results of this study. It would be out of place in a work of this character to attempt to characterise all the varieties, still less the forms in so polymorphous a Section, but I have given the principal varieties with references to some others, and by adopting Renauld's very natural system, as it seems to me, of grouping the forms of *H. aduncum* and *H. fluitans*, I hope to have afforded some guidance to the student desiring to be initiated into the study of this very intricate Section.

In dealing with unstable and plastic species such as these, it should be borne in mind that different authors have founded their systems of classification on different sets of characters, and the varieties in such cases will often overlap, *i.e.*, a group of forms combined under one system within a single variety may be separated up under another system and distributed over several varieties, and *vice-versa*. Hence although it is tempting to select the most salient varieties described by different authors, omitting the less marked ones in the various systems, such a course tends to obscure the real relationship of the plants and to lead to confusion. This is seen at once by taking as an illustration the various forms of *Sphagnum acutifolium*. The forms may be

grouped under the colour variations, or by some other characters, *e.g.*, the form and disposition of the branch-leaves; either may form a more or less natural and practically helpful arrangement, but it is obvious at once that to attempt to arrange one's herbarium under any combination of the two leads at once to confusion. I have therefore not attempted to include here certain varieties of authors employing a different system, though fully recognising that in themselves they are well deserving of notice.

It is imperative to remember in the Harpidia that the stem-leaves, not those of the branches, are referred to in the descriptions unless otherwise mentioned.

1 { Leaves not (or scarcely) auricled....2
  { Leaves with distinct auricles....5

2 { Stem with single outer layer of large, thin cells....3
  { Stem without any outer layer of large cells....4

3 { Robust, reddish; leaves with long acumen....*13. revolvens*
  { Slender, yellowish or green; acumen shorter....*13*. intermedium*

4 { Leaves red-brown along base, finely plicate....*12. vernicosum*
  { Leaves large, concave, rugose when dry, without dark base *9. lycopodioides*

5 { Leaves not (or only faintly) plicate when moist....6
  { Leaves distinctly plicate when moist....10

6 { Angular cells swollen, hyaline....7
  { Angular cells incrassate, yellowish....9

7 { Annulus present; ls. usually ovate-lanceolate, entire; nerve usually not reaching high in acumen....*7. aduncum*
  { Annulus absent; ls. longly lanceolate, finely toothed at base and apex; nerve usually running far into acumen....8

8 { Soft; stem-ls. flexuose, only the upper secund....*10. fluitans*
  { More rigid; ls. falcato-secund, faintly plicate, especially when dry *10*. exannulatum*

9 { Slender; ls. crowded, ½-1 line long....*8. Sendtneri*
  { Robust; ls. more distant, 1½-2½ lines long....*8*. Wilsoni*

10 { Nerve very stout....11
   { Nerve slender....13

11 { Ls. papillose at back; cells rather short....*14. decipiens*
   { Ls. not papillose; cells long and narrow....12

12 { Stems very radiculose, ls. deltoid at base....*15. commutatum*
   { Stems scarcely radiculose, ls. narrower at base....*15*. falcatum*

13 { Ls. long, longly filiform-acuminate....*11. uncinatum*
   { Ls. very short, shortly acuminate....*15*. sulcatum*

7. Hypnum aduncum Hedw., *non* L. (*Amblystegium Kneiffii* B. & S., p.p., Braithw. Br. M. Fl.) (Tab. LVII. L.).

Stems *usually slender and soft*, not so firm nor so robust as in most of the following species; *green or golden yellow, rarely reddish or dark coloured;* extremely variable in mode of branching, etc. Stems *erect* or floating, more or less regularly

pinnate or almost simple ; leaves *not crowded*, often secund but rarely strongly falcate, *usually moderately but not strongly hooked at the tip of the stems and branches ; not plicate, entire or very faintly sinuolate* at margin, ovate-lanceolate or oblong-lanceolate, variously acuminate, *wide and cordate at base*, strongly excavate, *with decurrent auricles enclosing a more or less semicircular space*. Nerve moderately strong, 50–60 μ wide at base, reaching $\frac{3}{4}$ length of leaf or into the acumen, but *usually not nearly approaching the apex*. Areolation *rather short, thin-walled*, linear-flexuose, about 80 μ in length, but sometimes more and often less, *10–12 times as long as wide ;* towards base *becoming laxer*, hexagonal-rectangular, at angles suddenly inflated, large, hyaline, forming *distinct, hyaline, decurrent auricles*. Perichaetial bracts lightly plicate. Seta long, 1–2 inches. Capsule oblong, inclined, curved. *Annulus present, broad*. Dioicous.

The forms may be classified as follows :—

Group TYPICUM Ren.

With something the habit of slender forms of *Amblystegium filicinum* or *H. intermedium*. Plants usually *slender*, firm, frequently pinnate ; stems and branches *usually hooked* at tips. Leaves rather closely set, secund and *more or less falcate, widely oblong-lanceolate or triangular-ovate at base, acumen rather short, channelled*, frequently subulate. Nerve thin, sometimes very short, usually reaching about half-way.

[The plants which may be looked upon as the type of *H. aduncum*, have the stems erect, 2-4 inches high, somewhat pinnate, firm and not very flexuose, with oblong-lanceolate, acuminate leaves, somewht falcate, especially the apical ones ; cells moderately firm and narrow to near the base, then becoming wider, hexagonal-quadrate at auricles. *Forma falcata* Ren. has the leaves more regularly and strongly falcate, subulate-acuminate. *F. laevis* Boul. has the leaves erect or adpressed, not flexuose at points, only slightly secund above, scarcely hooked ; the stems are therefore somewhat terete and cylindrical. This constitutes a transition to var. *pungens* of the next group. The above forms differ from var. *gracilescens* in the more longly acuminate leaves and narrower cells. Of somewhat more importance than those forms are the two following varieties.]

Var. β. *gracilescens* Schp. *Short ; slender*. Leaves *wider and shorter*, quickly narrowed to a *short acumen ; all lower cells wider, shorter ;* leaf-base less deeply and more widely excavate between the auricles. The var. *tenue* Schp. (*f. tenuis* Ren.) is probably a starved form of this.

Var. γ. *aquaticum* Sanio. Usually *submerged ; more robust ;* leaves *larger, more distant, longly acuminate*, flexuose at points. Nerve *stronger*, reaching $\frac{3}{4}$ length of leaf. Median cells *longer*.

Group KNEIFFII Ren.

Plants with less of the distinctive habit of Harpidium. Stems *slender*, softer and more flexuose. Leaves *more distant, not or only slightly secund and not falcate*, stems and branches *not or scarcely hooked ;* upper leaves generally wider and shorter, acumen *flat.*

Var. δ. *polycarpon* Bland. Stems procumbent, with numerous slender divisions, not pinnate. Leaves *somewhat distant, erecto-patent*, scarcely secund, upper *triangular-ovate with a short acumen*, strongly decurrent ; branch leaves often secund. Cells *rather short*, lax below. Fruit rare, but when present often produced in abundance.

[The var. *polycarpon* may be looked upon as the typical form in this group. The var. *attenuatum* Boul. is an extremely slender form with elongate, simple, almost filiform branches, the leaves distant and widely spreading, recalling *Ambl. Kochii.*]

Var. ε. *pungens* H. Muell. Brownish yellow. Stems and branches *rigid, terete and cylindrical* from the appressed, *closely imbricated* leaves, the apical *forming a cuspidate point.* Areolation rather long and narrow. A very distinct plant.

Var. ζ. *intermedium* Schp. Very variable, resembling var. *polycarpon* but with *larger, longer, more oblong-lanceolate leaves.* Cells rather longer and narrower.

[Forming a link between the var. *polycarpon* and the *pseudo-fluitans* group. *F. laxifolia* Ren. is a slender, elongate form, with more distant leaves, the comal ones appressed and sub-convolute, so as to form a slightly falcate, cuspidate point.]

Group PSEUDOFLUITANS Sanio.

Robust, mostly pinnate plants, often much elongate, frequently golden yellow. Habit of some forms of *H. fluitans*, but leaves usually broader. Stem-leaves *distant*, upper not differing appreciably from the lower, *large, widely lanceolate or oblong-lanceolate, gradually tapering to a long slender acumen ;* often sub-secund, more so at apex of stem, but not falcate. Median cells *elongate*, auricles very distinct and *occupying nearly all the width of the base, which is narrow, excavate in a small almost circular curve.*

[A very distinct group of large, usually aquatic plants, much more robust than those of the preceding groups, and resembling closely some forms of *H. fluitans*, but usually known by the form of the auricled leaf-base, the entire leaves, and somewhat wider, thin-walled areolation.]

Var. η. *paternum* Sanio. Yellowish green, orange or dark brown. Floating. Stems *much elongate*, attaining 12 or 18

inches, *robust*, from nearly simple to densely pinnate. Stem-leaves *distant*, erect, spreading or sub-secund, branch-leaves spreading, the apical both of stem and branches somewhat convolute and cuspidate ; all large.

[*F. gracilis* Ren. is a slender, less branched form, with narrower leaves]

HAB. Marshes, pools, etc., especially on clay, rarely in peat-bogs. Common. A lowland plant, rarely found at even moderate elevations. The var. *pungens* appears to be rare, the other varieties are more or less frequent.

This is an exceedingly protean species, and the characters given above, especially as regards the measurements of the cells, must be looked upon as approximate only. The variations are endless, in form of leaf, length of cells, size, mode of branching, etc., and there is perhaps a wider range of forms in this plant as regards habit and general characters than in any other British moss. The *forma tenuis* of the typical plant is an extremely delicate, dwarf plant, with stems sometimes scarcely exceeding an inch, and minute falcate leaves of about 1mm. in length, while the var. *paternum* may extend to a foot and a half in length, with branches of 3 inches or more, and large spreading leaves as much as 2 lines long, a single stem when spread out covering a sheet of foolscap paper. Some of these aquatic forms of the *pseudofluitans* group die down to a great extent in autumn, sending out new shoots in the spring, which undergo a rapid development, the greater part of the strong growth described above taking place in the course of two or three months. It follows therefore that the spring states are very different in appearance from those of the mature, summer development, which may be easily mistaken for a distinct variety.

In spite of its great variability, *H. aduncum* is rarely difficult to distinguish from the allied species, except from *H. fluitans*, which may almost always be known by the narrower leaves, denticulate at base, with very narrow cells remaining almost uniform to the base, and with a longer nerve ; there are, however, forms which are extremely hard to separate. *H. Sendtneri* is more robust, with the leaves more strongly falcate, the nerve stronger and cells firmer and narrower, but the parallel varieties *gracilescens* in each species are occasionally almost impossible to separate from one another. *H. vernicosum* has the leaves more falcate, plicate, and without decurrent auricles ; *H. revolvens* and *H. intermedium* are distinguished by similar characters, though the leaves are not plicate. On the other hand some forms come very near *H. riparium* and even *Ambl. Kochii*, and may be very hard to determine, though most frequently the distinct auricles afford a test character.

According to Schimper and Lindberg, the plant named *H. aduncum* by Linnaeus was not the present species but that known almost universally and described below as *H. uncinatum*. Lindberg therefore, and Braithwaite following him, restored the specific name *aduncum* to that plant, calling our present species *Hypnum* (or *Amblystegium*) *Kneiffii* Schp. It appears to me very undesirable to upset an almost universally accepted nomenclature in this way, and apart from the confusion thus introduced there are grave objections to applying Schimper's name *Kneiffii* to the typical, falcate-leaved plant from which he wished to separate it. I have therefore retained the established nomenclature.

8. Hypnum Sendtneri Schp. (*Amblystegium Sendtneri* Lindb., Braithw. Br. M. Fl.) (Tab. LVII. M.).

Typically more robust than *H. aduncum ;* green or golden, often reddish brown ; stems erect, divided, with few branches,

3–5 inches high; leaves *crowded*, $\frac{1}{2}$–1 line long, *secund*, *often strongly falcate* or almost circinate, strongly hooked at the tips of the stems and branches, somewhat flexuose and twisted when dry, more glossy than in *H. aduncum*, larger, *longly acuminate; not plicate, entire;* nerve *strong*, wider than in *H. aduncum*, about 60–100 μ wide at base, usually extending into the acumen; cells about equal to those of *H. aduncum* in length, but *narrower with firmer walls*, linear-flexuose, obtuse, almost uniform to base, the basal usually with thin, not porose walls, the angular cells firmer, *with somewhat thick walls, less hyaline*, often orange, forming distinct but usually small decurrent auricles. Capsule longer than in *H. aduncum*, sub-cylindric, sub-erect. Dioicous.

Hab. Bogs, marshes, etc., not common. Fr. rare, summer.

This species, on account of its strongly curved leaves, is more like several of the following species than *H. aduncum*, to which, however, it is more closely allied. It differs from that species also in the deeper colour, more glossy texture, wider nerve and usually firmer cell-walls, and the auricular cells are less enlarged and conspicuous. When very small and inconspicuous they may frequently be better observed on the stem with the leaves *in situ*, or if the leaves are rather roughly removed they will often be seen remaining attached to the stem.

The entire leaves, wider at the base, and more strongly falcate, will separate it from *H. fluitans*, the non-plicate leaves from *H. uncinatum* and *H. falcatum*, and the decurrent auricles from the other species which might be mistaken for it.

It is a less variable plant than the last, but has a very slender form analogous to the var. *gracilescens* of that (*f. gracilescens* Sanio), and so like it as to be barely distinguishable except perhaps by the stronger nerve. *F. trivialis* Sanio is an elongated aquatic form with leaves less falcate and subulate-acuminate. Very robust forms approach *H. Wilsoni*, but may usually be recognised by the closer branching, the smaller leaves, and less incrassate basal cells. No clear line however can be drawn between the two.

* **Hypnum Wilsoni** Schp. (*Amblystegium Sendtneri* var. *Wilsoni* Lindb., Braithw. Br. M. Fl.; *H. Sendtneri* var. *Wilsoni* Schp., Syn.) (Tab. LVII. N.).

Resembling *H. Sendtneri* in structural details, this plant is *much more robust*, 6–12 inches long, usually of *a deep yellowish green or golden colour*, the stems slightly divided and *very remotely pinnate*, the leaves *more distant, very large*, 1$\frac{1}{2}$–2$\frac{1}{2}$ lines long, oblong-lanceolate, gradually tapering to a long filiform acumen, falcate, giving a very robust appearance to the stems, which are however really slender and flexuose; nerve variable in width (Renauld describes it as narrower, but I have always found it as strong); cells rather wider, the basal with more incrassate, porose walls, the angular fewer and less distinct, forming smaller auricles.

Var. *β. hamatum* Lindb. (*H. aduncum* var. *hamatum* Schp.; *H. hamifolium* Schp., Syn.).

Very robust, stems *very regularly and closely pinnate*, more rigid ; leaves *beautifully and regularly circinate, very long*, especially in the acumen, *more crowded*.

HAB. Bogs, wet sandy shores, etc., rare. The var. β very rare. Fr. very rare, summer.

H. Wilsoni is too closely allied in all structural points to be separated from *H. Sendtneri*, but its great difference in habit and the size of its parts seem to warrant its retaining the rank of a sub-species. The nerve is somewhat variable, even in leaves from the same plant, but is certainly normally stout, much more so than in *H. lycopodioides*, which differs also notably in the plicate-rugose leaves when dry. The basal cells are frequently very incrassate, and the walls, as frequently happens in such cases, are then strongly porose.

The var. β is a very marked form, and altogether one of the most handsome of the Hypna ; the branching is very different from that of the type, but there is absolutely no difference in the structure of the leaves. It is sometimes quite submerged, and is then frequently encrusted with calcareous deposit.

9. Hypnum lycopodioides Schwaeg. (*Amblystegium lycopodioides* De Not., Braithw. Br. M. Fl.) (Tab. LVIII. A.).

Resembling the more robust forms of *H. Sendtneri* and *H. Wilsoni ;* the stems *with few divisions which are simple or very slightly branched*, slender and flexuose, but rendered *very robust and tumid by the densely crowded, large, concave leaves ;* forming large tufts of *a rich golden colour*, 4–10 inches high. Leaves *very large*, 2–2½ lines long, *very concave*, widely oblong-lanceolate, tapering to a fine, moderately long acumen, *falcate, but not strongly so, hardly hooked at the tips of the stems*, very slightly decurrent at the wide base, which is broadly, not semi-circularly excavate, *entire*, when dry *plicate and irregularly rugose ;* nerve *narrow*, 30–50 μ, reaching to the base of the acumen. Cells as in *H. Wilsoni*, the basal *incrassate, with the walls porose*. *Dioicous*.

HAB. Deep bogs and pools ; rare. Fr. spring, very rare.

This plant resembles *H. scorpioides* in the tumid stems with large rugose leaves, but the colour is usually different, and the long nerve quite distinctive. It is so different in habit, arrangement and form of leaves, etc., from *H. Wilsoni* that I do not feel able to follow Renauld in making one a sub-species of the other. It is in appearance one of the most distinct of the species of this Section.

10. Hypnum fluitans L. (*Amblystegium fluitans* De Not., Braithw. Br. M. Fl.) (Tab. LVIII. B.).

Very variable. Usually *soft and slender*, tall, irregularly or pinnately branched, pale green, yellowish, chestnut brown, or dark brown. Leaves more or less secund or falcate, usually much narrower than in *H. aduncum*, *narrowly lanceolate or oblong-*

lanceolate, very gradually tapering to a long slender flexuose point ; $1\frac{1}{2}$–2 lines long, *not striate ;* narrow at base and widely, not deeply excavate, sometimes almost truncate and straight, at margin usually *distinctly denticulate*, especially at apex and base ; nerve distinct, narrow or wider, *usually reaching high in the acumen, or even to apex.* Cells *long and very narrow*, 100–120 μ long, 20-30 times as long as wide, but variable, linear-flexuose, obtuse, *somewhat incrassate ; almost uniform to the base ;* at angles enlarged, hyaline or coloured, *forming more or less distinct auricles often reaching to the nerve.* Seta long, 2 to even 4 inches ; capsule more or less inclined, variably curved. Annulus *none. Autoicous*, rarely dioicous or barren with imperfect flowers.

The numerous forms of *H. fluitans* may be classified as follows :—

Group AMPHIBIUM Ren.

Usually pale green, less frequently brown. Stems slender, little and irregularly branched, more rarely pinnate. Leaves distant, *only slightly secund*, more so at the tip of the stem, flexuose, *very narrow*, usually *distinctly denticulate at apex*, more faintly towards base. Nerve *narrow*, 45-65 μ, usually reaching half or three-fourths the length of the leaf. Median cells very long and narrow, scarcely altered until the extreme base, angular *not much enlarged*, forming *small and indistinct, scarcely inflated auricles ;* basal cells *not incrassate.*

[The above description may be taken as applying to the typical *H. fluitans* L. ; it usually forms dense, soft, floating tufts, specially characterised by the narrow, finely acuminate, flexuose leaves, falcate only at the tips of the stems. The following are the most noteworthy varieties.]

Var. β. *Jeanbernati* Ren. (var. *paludosum* Sanio). *Pale green above.* Leaves oblong-lanceolate, *rather shortly and widely acuminate ;* nerve narrow ; angular cells *very ill-defined.* Seta sometimes very long.

Var. γ. *atlanticum* Ren. *Deep glossy green ;* stems scarcely branched ; leaves *wider*, from an *ovate base quickly narrowed to a wide and comparatively short point ;* cells *wider, chlorophyllose*, basal *wider and shorter*, the angular scarcely distinct.

Var. δ. *gracile* Boul. Stems *very slender*, little branched, leaves *distant*, somewhat spreading, narrow, with a long slender acumen.

Var. ϵ. *setiforme* Ren. Stems elongate, *straight, almost simple ;* leaves *distant*, somewhat *spreading*, straight and scarcely secund, *very long, gradually tapering to a very long setaceous strongly toothed subula.*

Var. ζ. *Robertsiae* Ren. & Dixon. *Variously coloured, sometimes very bright golden mixed with purplish red, glossy ;* stems

floating, *elongate, almost simple*, leaves rather *closely set, sub-erect with spreading points*, not secund, or falcate (but sometimes rather strongly so) only at the tips of the branches, tapering to a long fine sharply toothed subula; areolation, especially at the base, rather *incrassate*.

[The above are what appear to me the more important of the very numerous varieties and forms that have been recorded as British in this group. The var. *atlanticum* is, I am inclined to think, a somewhat degenerate or undeveloped form of var. *Jeanbernati*; it is very marked in the habit, chlorophyllose leaves, lax basal areolation, and short wide acumen. It resembles the var. *gracile* somewhat in habit, but that has much more slenderly acuminate leaves. The var. *falcatum* sometimes produces a very similar form. The var. *Robertsiae* is an interesting plant as forming a link between the present and the *falcatum* group, of which it approaches the var. *anglicum*. The original plant is an exceedingly beautiful one in the variegated colouring, but later gatherings collected earlier in the year lack much of its brightness. The var. *squalidum* Ren. and Dixon (Journ. of Bot. 1901, p. 277) was described from very marked and striking plants, especially in the lower leaves; specimens gathered later however in the same locality show very different and less marked characters, and it is possible that the original plants owed something of their peculiar features to abnormal aquatic conditions.]

Group FALCATUM Ren.

More robust. Yellowish, often becoming red above, chestnut or deep purplish-brown below. Leaves usually glossy, mostly all *falcate, strongly hooked above*, more or less truncate at insertion, only faintly denticulate at point; nerve *broader*, 60–100 μ at base, reaching to about $\frac{3}{4}$ length of leaf. Basal cells *incrassate, often coloured orange*, the angular not much enlarged, forming more or less distinct, not inflated auricles.

Var. η. *falcatum* Schp. Yellowish, brown below. Stems *simple or very slightly branched*. Leaves close, moderately long, tapering to a rather short subula.

Var. θ. *anglicum* Sanio (*A. fluitans* var. *Holtii* Sanio, Braithw. Br. M. Fl.). In *dark brown tufts, yellowish above;* stems elongate, rather robust, *pinnate with short branches;* leaves ending in a long flexuose subula.

Var. ι. *Arnellii* Sanio. *Very robust.* Floating, stems *regularly and sometimes closely pinnate*. Leaves *long*, with long fine denticulate points. Nerve *very stout*, but not reaching high in the acumen. Median cells rather thin-walled; the angular not much enlarged, forming slightly widened but not inflated auricles.

HAB. Peat-bogs, pools, etc., very rarely on calcareous soil; common. The vars. *Jeanbernati, falcatum*, frequent; var. *atlanticum* abundant on some of the high moorlands of the north of England, elsewhere rare; the other varieties named above apparently rare. Fr. common, summer.

Besides the forms mentioned above there are many others which cannot be described in a work of limited compass; when submerged the plant often

becomes beautifully plumose with spreading leaves, in other cases the leaves are close, more or less erect when dry, very long and very silky. In habit, colour, etc., this species is nearest to *H. aduncum*, from which it is usually known by its narrower, more silky leaves, denticulate at margin, more longly nerved, with longer, very narrow cells, almost uniform to the base; but intermediate forms occur which are often very difficult to separate, especially as they are usually the more submerged forms, and mostly barren; typical *H. fluitans* being usually very fertile, and distinct in the autoicous inflorescence. *H. aduncum*, it should be remembered, is distinctly a plant of the plains, never perhaps found with us at an elevation of 500ft., rarely reaching 250ft. *H. fluitans* has a much wider range, though as we ascend higher its place is generally taken by *H. exannulatum*, which rarely descends to the level of the plains. *H. uncinatum* differs in the pale colour, strongly plicate leaves, etc.; most of the other species have shorter, wider, more circinate leaves, of a more rigid texture, and in habit and other respects are distinct.

* **Hypnum exannulatum** Guemb. (*Amblystegium exannulatum* De Not., Braithw. Br. M. Fl.) (Tab. LVIII. C.).

Differs from *H. fluitans* in the plants usually *more compact and rigid*, less soft and flexuose, *more pinnately branched*, mostly of a *deeper, often purplish colour; typically but less commonly green or yellowish;* the leaves *closer, more strongly falcate*, twisted when dry, not rigidly circinate, glossy at back and *frequently striate, especially when dry, strongly hooked at the tips of the stem and branches*, mostly longly and finely acuminate from a *wider* base; nerve often *stronger*, usually purplish brown, mostly reaching nearly or quite to apex. Margin almost always denticulate, especially near base. Cells *frequently shorter and wider*, but not constantly so, the auricular usually abruptly dilated and very distinct, large, rectangular, hyaline, inflated, mostly thin-walled, forming rather large, *widened, inflated* conspicuous auricles, often reaching to the nerve. *Dioicous*, rarely autoicous.

Group TYPICUM.

The typical form (*H. fluitans* var. *pinnatum* Boul.) is usually green or yellowish, but often darker, with a purplish tinge, moderately robust, with ovate-lanceolate leaves, not very longly acuminate, usually more or less striate when dry, though scarcely plicate and never deeply sulcate. Cells moderately long and narrow. The *f. stenophylloides* Ren. has narrower, more finely acuminate, strongly falcate leaves, forming a transition to var. *falcifolium*.

Var. *β. brachydictyon* (*H. fluitans* var. *brachydictyon* Ren.). Usually *green;* stems *slender*, tall. Upper leaves only slightly secund, sometimes sub-erect, *short*, from an ovate base *shortly and broadly* acuminate, usually plicate when dry. Nerve stout. Cells *short*, oblong-linear, *lower very short, wide*. Auricles very distinct.

Var. γ. *purpurascens* Schp. Firm, *compact, robust,* closely pinnate, *of a more or less bright red or purplish colour ;* leaves crowded, cells moderately long, incrassate, the angular few, long, curved, slightly incrassate, resembling those of the group *Rotae.* Nerve *often very strong and thick,* 60-90 μ wide at base, *purple,* usually percurrent.

Group ROTAE Ren.

Almost always sterile, usually purplish or brown, leaves less crowded, much narrower and longer, with attenuated setaceous points, usually sharply toothed. Nerve strong, often percurrent, sometimes excurrent ; areolation longer and much narrower. Auricles very distinct, widened, the outermost cells very large, longly rectangular and incurved (Tab. LVIII. C., 1bc), slightly incrassate.

Var. δ. *falcifolium* (*H. fluitans* var. *falcifolium* Ren. ; var. *stenophyllum, Handb. Ed. I. ; H. exannulatum* var. *Rotae* Schp., Syn., Braithw. Br. M. Fl.). Usually *purple or red,* more elongate, less compact and rigid ; leaves less crowded, *falcate, very long and narrow* (2–2½ lines), *often strongly denticulate, cells very long and narrow.* The *f. viridis* Boul. is a more slender, less pinnate, green form, with looser leaves.

HAB. Bogs, mostly in more elevated situations than is usual with *H. fluitans.* Common. The type common in mountain bogs and wet places, the varieties rarer, on mountains, var. *falcifolium* in high cold streams and pools. Rarely fruiting.

Hypnum fluitans, though by no means absent in elevated situations, is preëminently a lowland species, while the sub-species is a more sub-alpine plant, and is usually readily known by its more rigid, pinnate growth, with the leaves broader, crowded and often plicate. It is sometimes very much like *H. falcatum* in leaf structure, but that species is more yellowish, rarely purple, with the leaves more distinctly plicate both when wet and when dry, less denticulate above, and with more or less numerous paraphyllia, and is less regularly pinnate. The var. *brachydictyon* occasionally has the stems terete and cuspidate (as in *H. aduncum* var. *pungens*) with the leaves all erect and not at all falcate (*f. orthophylla* Ren.). I have gathered this form in Sutherland. The var. *purpurascens* is in some of its most brightly coloured forms one of the most brilliant of our mosses.

The var. *falcifolium* in its extreme forms is very marked ; in outline the leaves resemble those of *H. fluitans,* but the colour and branching are distinct are distinct, the nerve stronger, the habit more robust, and the leaves often sharply toothed.

The green form, which may be looked upon as typical, is rare, and resembles *H. Sendtneri,* but has the leaves usually plicate when dry.

I have thought it best on the whole to retain *H. exannulatum* as a sub-species rather than to reduce it, with Renauld, to the level of the other groups of *H. fluitans.* It is without doubt closely allied, but there are I think sufficient differences (apart from the inflorescence, which is not constant) to justify us in giving it the somewhat higher rank. Forms connecting the groups Amphibium and Falcatum are not unfrequent, and the same is the case with the typical group of *H. exannulatum* and the group Rotae, but transition forms between *H. fluitans* and *H. exannulatum* are in my experience extremely rare. I have endeavoured however to depart as little as possible in nomenclature and order from Renauld's arrangement.

11. Hypnum uncinatum Hedw. (*Hypnum aduncum* L., *non* Hedw.; *Amblystegium aduncum* Lindb., Braithw. Br. M. Fl.) (Tab. LVIII. D.).

Pale green or golden green, very rarely of a deeper colour, never red or purple. Stems *rarely erect,* usually procumbent, often interlaced with other mosses, or more robust and tufted, distantly or closely pinnate, *rather slender;* 1–4 inches long. Leaves more or less crowded, regularly falcate or almost circinate, little altered when dry or in the softer forms spirally flexuose at points, glossy, *strongly longitudinally plicate when wet and dry, strongly hooked* at the tips of the stems and branches, of *thin, not solid texture;* narrowly oblong-lanceolate, gradually tapering to a *very fine, filiform acumen,* at margin usually *denticulate* at point and often at base, rarely entire; at base often broad and flat, with minutely decurrent auricles and hardly excavate, but always *more or less decurrent and auriculate;* nerve *very narrow,* 30–35 μ wide at base, extending *high in the acumen.* Cells very narrow, long, flexuose, somewhat tapering and pointed, *thin-walled,* almost uniform to base; angular more or less numerous, hyaline, but not very large nor inflated, partly decurrent and partly extending above the base at angles, forming *rather small, not well-defined auricles.* Perichaetial leaves *very long,* straight, erect, sheathing, *plicate;* seta variable in length, capsule sub-cylindric, arcuate, orange-red, annulate. *Autoicous.*

Var. β. *plumulosum* Schp. *Very slender, closely pinnate;* leaves *small, less deeply striate,* sometimes almost smooth, less denticulate or sub-entire; seta shorter, capsule smaller.

HAB. Wet rocks and walls, principally in alpine and sub-alpine districts; common. The var. β rare, on mountains, etc; North of England; N. Wales; Scotland. Fr. summer.

Usually a very distinct species in the pale colour, thin, strongly plicate, very finely acuminate, denticulate leaves with narrow nerve and small ill-defined auricles, which are, however, always more or less developed. Numerous forms occur on the continent, and perhaps still more strongly marked in N. America, but the more distinct of them do not appear to occur here, though the var. *plumosum* Schp., a somewhat distinct form with regular, close, complanate pinnation, but connected with the type by a graduated series of forms, is found occasionally; it is intermediate between the type and the var. *plumulosum.* The latter variety is very distinct, not only in the slenderness, but in the often hardly striate, almost entire leaves.

The autoicous inflorescence and the very long, straight, conspicuous perichaetia are also marked and useful characters of the present plant.

12. Hypnum vernicosum Lindb. (*Amblystegium vernicosum* Lindb., Braithw. Br. M. Fl.) (Tab. LVIII. E.).

Typically *slender,* but rather firm and rigid, 2–4 inches high, more or less erect, *yellowish green, varicgated with deeper colour,*

sometimes yellowish, brown, or reddish, but never deep red nor purple, glossy, pinnately branched. Stem *without central-strand*, cells of outer layers small, incrassate; outermost layer *not enlarged*. Leaves *rather small*, 1–1½ lines long, crowded, *falcate-circinate*, concave, *finely plicate, especially when dry*, strongly hooked at the tips of the branches, from a short, wide, oblong base *rapidly and rather shortly and widely acuminate*, acute and sometimes finely apiculate, *entire; truncate, not decurrent nor excavate at base;* nerve rather weak, *usually vanishing just above the middle;* cells *long and very narrow*, flexuose, subobtuse, the walls slightly incrassate; two or three rows at insertion commonly rather wide, oblong-hexagonal, more or less incrassate, the extreme basal row *hyaline, above these a single row or sometimes two purplish, forming a coloured line* across the base just above the insertion; *not distinct nor decurrent at angles*, or rarely with a very few minute cells forming almost obsolete, minute false auricles. Capsule *annulate*. Dioicous.

Var. *β. majus* Lindb. Much more robust, brown. Resembling the more robust forms of *H. Sendtneri* or even *H. Wilsoni*. Leaves *less falcate, large*. Nerve wider, cells longer.

HAB. Sub-alpine and mountain bogs, rare. The var. *β* very rare; Shropshire; Carmarthen; Merioneth; Lancashire. Fr. very rare, summer.

This species in habit resembles *H. Sendtneri* and *H. intermedium*, but differs from both in the strongly plicate leaves, from the former also in the shorter acumen and absence of decurrent auricles. A form however occurs with the "false auricles" strongly developed, and the leaf apex faintly denticulate, which is very likely to be taken for *H. Sendtneri*. From *H. revolvens* proper it differs in the less robust habit, paler colour, less incrassate median cells, shorter plicate leaves, shorter nerve, and usually more numerous sub-hexagonal basal cells. It is less markedly different from *H. revolvens* sub-spec. *intermedium*, but the distinctly plicate leaves are usually sufficient to distinguish it, and the nerve is usually shorter. From all these plants the structure of the stem separates it, and determinations should hardly be made without sectioning the stem, as forms of *H. intermedium* occasionally have the leaves somewhat plicate, or at least striate, when dry. *H. vernicosum* is much like forms of *H. falcatum*, but that species is less pinnate, with stout nerve and distinct auricles.

It is necessary in determining species of this section to examine leaves from the stems, not the branches, and to remove them with great care, as otherwise the angular decurrent cells though present may be left attached to the stem, and the leaf appear falsely to be non-auricled; truly non-auricled leaves are only found in the present species and in *H. revolvens* and its subspecies. In the present plant one or two rows of hyaline thin-walled cells are usually observable below the coloured incrassate cells, along the line of insertion; these are somewhat intermediate between the foliar and stem tissue, and may be considered characteristic of the present species; when only a few of these are detached at the angles, as frequently occurs, they give rise to the minute false auricles mentioned in the above description.

13. Hypnum revolvens Swartz (*Amblystegium revolvens* De Not., Braithw. Br. M. Fl.) (Tab. LVIII. F.).

Robust, soft, stems irregularly divided, unequally and *distantly, not pinnately branched*, in dense tufts of *a deep reddish purple*, beautifully variegated with golden green and orange, *very glossy* and with almost a metallic sheen. Stem in section showing a *small, distinct central-strand;* outer layers of cells small, incrassate, *with a single outermost layer of larger, hyaline cells*. Leaves *large and densely crowded*, so that the stems appear *robust and tumid, strongly and very regularly circinate* so as often to form a closed circle, when dry *little altered, only slightly flexuose at point, not plicate, longly and finely acuminate* from a widely oblong base, entire or sinuolate at margin, concave, canaliculate, at base *truncate, not excavate nor decurrent;* nerve narrow, but rather strong, reaching to about $\frac{3}{4}$ the length of the leaf. Cells *very long, narrow and incrassate*, narrowly linear and vermicular, with the walls, in the older leaves especially, very thick and porose, 20–30 or even 40 times as long as wide, uniform, narrow and prosenchymatous almost to base, at insertion deeply coloured, with very incrassate and porose walls, rather wider, subrectangular, in one or two rows; *not distinct nor decurrent at angles*, or only a very few falsely auriculate, as described under the last species. Seta long, 1½–2 inches. Capsule large, oblong, inclined, curved; annulus present. Autoicous or dioicous.

Hab. Bogs, frequent. Fr. rare, spring.

This is one of the most beautiful species of the Section, sometimes so robust as to resemble *H. scorpioides;* but at other times more slender and approaching the sub-spec. *intermedium;* the var. *Cossoni* Ren. (*H. Cossoni* Schp.) is I think scarcely more than a section of the transitional forms connecting the two extremes, having the inflorescence of the latter but most of the habit of the former. It seems impossible to characterise it satisfactorily, and I have thought it best to omit it altogether.

H. revolvens varies greatly in size, being sometimes as robust as the larger forms of *H. scorpioides*. The habit and the non-decurrent, straight insertion of the leaves separate it from all other species except the last, for which the description of that species may be consulted.

*** Hypnum intermedium** Lindb. (*Amblystegium intermedium* Lindb., Braithw. Br. M. Fl.) (Tab. LVIII. G.).

Differs from *H. revolvens* in the *more slender stems* and usually *pale, yellowish or green colour*, the smaller leaves variously twisted and sometimes slightly crisped when dry, *with the acumen shorter*, often as short as in *H. vernicosum;* cells *shorter, less incrassate*, 10–15 times as long as wide or less, not so incrassate nor so coloured at base, a few basal rows usually wider and parenchymatous; at extreme angles there are frequently a few larger, hyaline cells forming very minute, somewhat inflated but not decurrent auricles. Stem section as in *H. revolvens*. Dioicous.

HAB. Bogs, rare; usually barren.

In its best marked forms very different from *H. revolvens*, but every transitional form may be found, and these occur even in the same tuft.

14. Hypnum decipiens Limpr. (*Hypnum Notarisii* Boul., nonnull. auct.; *Thuidium decipiens* De Not. Handb. Ed. 2; *Amblystegium decipiens* De Not., Braithw. Br. M. Fl.) (Tab. LVIII. H.).

Resembling very closely slender forms of *Hypnum commutatum*, and scarcely distinguishable without the aid of the microscope. Secondary stems erect, *not glossy*, frequently forked or divided, the divisions simply pinnate, with *short*, close, or irregularly placed branches, which are often hooked at the apex, bright or yellowish green. Stems rather slender, soft, fragile, clothed with *short*, multifid paraphyllia and often with *radicular tomentum*. Stem-leaves *not crowded*, spreading or sub-secund, *not much appressed when dry*, *widely deltoid* and suddenly narrowed at base to the insertion, tapering to a short, often fine acumen, slightly decurrent and auriculate at base, *strongly plicate*, margin slightly revolute at base, denticulate at the widest part of the base, almost entire above, or denticulate; nerve strong, reaching nearly to apex; upper cells *linear-rhomboid and vermicular or elliptic-hexagonal*, variable in width, but usually rather wider than in the last species, longer and narrower in the acumen, gradually becoming *shorter and wider towards the base; at basal angles larger, lax, hyaline*, irregularly hexagonal, forming *more or less distinct, often coloured auricles*. Leaves *usually showing papillae from the upper end-walls of the cells*. Branches slender, short, the leaves spreading and secund or strongly falcato-secund, ovate-lanceolate, *more or less longly acuminate*, finely denticulate; cells shortly linear-vermicular, or narrowly elliptical, shorter and wider at base, *sparsely but sharply papillose* at back. Seta long, capsule arcuate. *Dioicous*.

HAB. Wet places on mountains, very rare; Highlands of Scotland; Yorkshire. Fruit extremely rare, not found in Britain.

In the habit, the falcate branch leaves, and other points, this species closely resembles *Hypnum commutatum*. It is a more slender plant with shorter branches than the usual forms of that moss, so that the fronds are much narrower in outline, and may at once be distinguished under the microscope by the papillose leaves with the cells, especially towards the base, much looser, being both shorter and wider. The leaves when dry, moreover, are somewhat crisped, and are quite dull, not slightly glossy as in *H. commutatum*.

There has been much difference of opinion as to the true systematic position of this plant, several authors placing it in *Thuidium*, near *T. Blandovii*, as in previous editions of this work; the papillose leaves form the chief argument for placing it in that genus, and that view is supported somewhat by the fact that in *T. Blandovii* the form of the branch-leaves, the areolation,

and the character of the papillae all show a distinctly intermediate condition between the typical characters of Thuidium and those of the present plant. The enlarged alar cells are on the other hand a strong argument for the other view, as is the general resemblance to *H. commutatum.*

15. Hypnum commutatum Hedw. (*Amblystegium glaucum* Lindb., Braithw. Br. M. F.) (Tab. LVIII. I.).

Typically *slender*, the stems more or less erect or ascending, divided, *regularly and complanately pinnate and plumose*, 3–6 inches long, *bright green, orange internally*, frequently encrusted with calcareous matter. Very variable in size, branching, and colour. Stems *more or less densely tomentose with brown radicles*, and *with numerous lanceolate or linear-subulate paraphyllia*. Leaves rather small, about 1 line long, usually more or less strongly falcate or circinate, but often pointing in various directions or more or less irregularly spreading, branch-leaves rather narrower, more regularly falcato-secund and homomallous; stem-leaves *widely cordate-triangular from a broad decurrent base*, rapidly narrowed to a long, channelled, tapering acumen, which is very flexuose and *more or less crisped when dry; deeply plicate, strongly denticulate at basal margin*, more indistinctly above; nerve green, *very thick and strong*, especially at base, reaching *about half-way up the acumen;* cells short but narrow, 50–80 μ long, *8–10 times as long as wide*, tapering, but not very acute, linear; at base lax, sub-hexagonal, pellucid, especially at margin; below these at angles suddenly large, *hyaline*, inflated, forming *large decurrent auricles*. Perichaetial bracts plicate. Seta long, $1\frac{1}{2}$–2 inches; capsule large, cylindric, arcuate, bright orange-brown, annulate. Dioicous.

Hab. Bogs and streams, most abundant in calcareous soil. Common. Fr. early summer.

Another very protean species, in its slender forms resembling *Amblystegium filicinum*, but more densely and regularly pinnate, with wider, softer, plicate leaves more flexuose when dry, and especially with longer, narrower, linear, not hexagonal areolation. It varies much in colour, but most of all in degree of robustness, size of leaves and mode of branching, and some forms can hardly be separated from the sub-species *H. falcatum*. It cannot easily however be taken for any other species if due attention be paid to the wide leaf base, plicate leaves with large decurrent auricles, and to the presence, often in great abundance, of radicular tomentum and of paraphyllia. Although dioicous it is more frequently found in fruit than many of the allied species.

For the differences from *H. decipiens* see the description of that species.

*** Hypnum falcatum** Brid. (*Amblystegium falcatum* Lindb., Braithw. Br. M. Fl.) (Tab. LVIII. J.).

More robust, of a deeper, often orange-brown colour, stems stouter, *more distantly and irregularly pinnate or sub-pinnate*,

the branches often few and more or less ascending or erect, *not regularly plumose;* radicles *few or none;* leaves crowded, *much larger and longer than in H. commutatum,* rendering the stems and branches stouter; *more regularly and strongly falcato-secund, more rigid and hardly flexuose when dry,* 1–2 lines long, widely or narrowly oblong-lanceolate from a *less expanded, not cordate-triangular base,* more gradually but more widely acuminate, of more solid texture; nerve very strong and thick, often purplish; cells more incrassate, linear-flexuose, the angular *strongly incrassate, orange-brown,* often opaque, forming less distinctly marked decurrent auricles. Seta and capsule rather shorter and stouter.

Var. β. *gracilescens* Schp. *Very slender and graceful,* in soft, rather dense tufts, procumbent or ascending, stems irregularly divided, the divisions long, slender, almost simple or with few, somewhat pinnate, very short branches. Leaves very regularly and neatly falcato-secund or circinate, *very small,* about ½ line long, *glossy, hardly plicate,* nerve moderately strong, reaching ¾ the length of the leaf. Cells *narrow, but rather short.*

Var. γ. *virescens* Schp. (*H. irrigatum* Zett.; *Ambl. falcatum* var. *fluctuans* B. & S., Braithw. Br. M. Fl.). *Aquatic; dark green or blackish;* stems longly denuded, *clothed with the bristle-like nerves of the old leaves.* Leaves slightly falcato-secund or straight and erecto-patent and lightly secund only at the tips of the branches, *hardly plicate;* ovate-lanceolate or narrowly triangular-lanceolate, tapering to a wide and often rather obtuse point, or acute; nerve *extremely thick and wide,* reaching apex or lost just below; angular cells hardly distinct.

HAB. Bogs, principally at higher elevations than *H. commutatum;* frequent. The var. β on wet mountain rocks, rare. North Devon; Yorkshire; Staffordshire; Ben Lawers and Craig Chailleach. The var. γ in calcareous springs and mountain streams, rare. Fr. summer.

In habit *H. falcatum* is so different from typical *H. commutatum* that the two could hardly fail to stand as separate species were it not for the fact that numerous intermediate forms occur, principally on the side of the latter, forming a more or less graduated passage from the one to the other. Thus robust forms of *H. commutatum* with densely radiculose stems and regular pinnate branching will give rise to stout, almost simple offshoots with the long, narrow leaves and the general characters of *H. falcatum.* The latter also frequently occurs in a somewhat slender form, showing much resemblance to *H. vernicosum* and some forms of *H. exannulatum,* but readily distinguished from the one, and from all forms of *H. revolvens,* by the auricles, and from the other by the more solid less denticulate leaves with less marked auricles, and from both by the numerous paraphyllia. The var. *gracilescens* on the other hand is a very distinct and extremely pretty form, coming nearer to *H. sulcatum,* but rather more robust and with longer, proportionately narrower leaves more of the *falcatum* form, with longer nerve and narrower cells. It is much like *H. Bambergeri,* but the nerve at once distinguishes it.

The var. *virescens* is a very striking plant; it is abundant in some of the calcareous springs of West Yorkshire and Teesdale; it shows considerable

variety in branching, and appears to be derived from *H. commutatum* quite as frequently as from *H. falcatum*. In dry seasons it is sometimes less aquatic, and then frequently loses much of its characteristic features, coming very close to one or other of the above plants, which moreover not rarely run into forms showing a distinct approach to the variety. I do not think the presence or absence of paraphyllia can be relied upon as a character.

* **Hypnum sulcatum** Schp. (*Amblystegium glaucum* var. *sulcatum* Lindb., Braithw. Br. M. Fl.) (Tab. LVIII. K.).

Resembling *H. falcatum* var. *gracilescens* but *still more slender;* stems *more or less regularly pinnate*, extremely slender, soft or rigid, more or less prostrate or ascending; radicles *few or none*, paraphyllia *numerous*. Tufts dull greyish green or yellowish. Leaves *very small, hardly ½ line long*, regularly falcato-secund or hamate, irregularly but distinctly plicate, *widely ovate and suddenly acuminate, or ovate and more gradually tapering*, but wider and shorter, proportionally, than in *H. falcatum*, nerve *comparatively weak, sometimes extremely faint*, but usually wide at base and soon becoming narrow, reaching *usually about half way*, sometimes more; margin sinuolate or obsoletely denticulate; cells *short, elliptic-linear*, thin-walled, *4–6 times as long as wide*, but somewhat variable; angular cells large, orange, forming rather distinct auricles usually reaching to the nerve. Fruit unknown.

HAB. Wet alpine rocks, very rare; Ben Lawers; Craig Chailleach.

This is probably sufficiently distinct from *H. falcatum* in the wide leaves, short, often faint nerve, and especially the short lax areolation, to be considered a sub-species rather than a variety, though it must be held to belong to that plant rather than to *H. commutatum*, of which however it has the branching. The var. *subsulcatum* Schp., indicated from Ben Lawers, appears to me a slight form only, and an approach to *H. falcatum* var. *gracilescens*. There may indeed be found a great number of forms more or less intermediate between the two plants; and in the condition of the nerve, especially, a wide range of variation may be found, even among the leaves from a single stem. There appears little doubt that *H. Breadalbense* F. B. White represents one of these forms, and hardly differs from the var. *subsulcatum*.

H. sulcatum is fairly abundant about the summit of Ben Lawers, but occurs nowhere outside that range, I believe, in our islands.

C. DREPANIUM.

Plants usually more or less pinnately branched, sometimes very regularly plumose. Leaves mostly small, strongly and regularly falcate or circinate, or less curved, but secund and homomallous, then usually pointing upwards; nerveless or with a short double nerve, more or less longly and finely acuminate. Median cells long and narrow, angular usually distinct. Plants rarely paludal. Paraphyllia few, or none.

One of the most natural of the sub-divisions of Hypnum; *H. incurvatum* alone, perhaps, of our British mosses, presenting some considerable divergence from the general type; in the form and direction of the leaves, however, it is quite analogous to *H. cupressiforme* var. *resupinatum*. With those two exceptions all the species are at once known by the more or less falcato-secund, two-nerved or nerveless, longly acuminate leaves all curved downwards, usually in two rows, one on each side of the stem or branch, so that the upper side or back of the stem is smooth, often glossy, while the lower side or front is irregular and rough with the leaf-points. *H. cupressiforme* may be looked upon as the type of this Section, and the student will do well to study it in its various forms as a help to the understanding of the allied species, which it is usually convenient to describe by comparison with the plant in question.

1 { Stem rigid; branches densely pinnate; ls. deeply plicate *27. crista-castrensis*
  { Ls. not, or only slightly plicate when moist 2

2 { Ls. with broad, cordate, auriculate base 3
  { Ls. ovate-lanceolate, not widely cordate at base 4

3 { Ls. serrulate, usually crisped and twisted at points when dry *26. molluscum*
  { Ls. entire or sinuolate only, scarcely crisped ..... *24. procerrimum*

4 { Ls. not at all auricled ..... *21. hamulosum*
  { Ls. more or less distinctly auricled 5

5 { Angular cells swollen, hyaline 6
  { Angular cells more or less thickened or coloured 7

6 { Ls. with widish acumen; stem sparingly branched ..... *19. Patientiae*
  { Ls. with very fine acumen; stem pinnate ..... *21. callichroum*

7 { Ls. secund, pointing upwards, narrow; branches incurved *16. incurvatum*
  { Ls. usually falcato-secund, generally wider at base 8

8 { Leaf-margin narrowly revolute almost to apex ..... *20. revolutum*
  { Margin plane, or slightly recurved only 9

9 { Leaves circinate; cells incrassate; stem scarcely pinnate *23. Bambergeri*
  { Leaves more or less falcate; cell-walls thinner; stem usually pinnate ... 10

10 { Ls. rather wide at base, red-brown at junction with the brown stem *18. imponens*
   { Ls. narrower at base, not coloured at junction with the paler stem 11

11 { Capsule oblong-cylindric; ls. rarely strongly denticulate *17. cupressiforme*
   { Capsule shortly oval; ls. sharply denticulate ..... *25. canariense*

16. Hypnum incurvatum Schrad. (*Stereodon incurvatus* Mitt., Braithw. Br. M. Fl.) (Tab. LIX. A.).

Very slender, green or yellowish green, in *small silky tufts*. Stems *prostrate*, irregularly branched or sub-pinnate, branches short, usually curved. Leaves rather close, *homomallous and usually pointing upwards*, almost straight or more or less curved

and falcato-secund, less spreading when dry, *very small*, ½ line long, *oblong-lanceolate, gradually and longly acuminate*, at margin plane, entire or faintly denticulate at apex, nerve double, very short, or almost obsolete; cells narrowly linear-hexagonal, somewhat flexuose, tapering, but not acute, pellucid, thin-walled, *5–10 times as long as wide*, at angles *numerous*, more or less quadrate, *proportionately large, but not forming clearly defined auricles*. Perichaetial bracts not plicate. Seta ½–¾ inch; capsule *inclined and sub-horizontal*, oblong-cylindric, *curved;* lid conical, acute, or acuminate. Autoicous.

HAB. Sub-alpine and mountain rocks, especially calcareous ones. Rare. Fr. early summer.

This little moss bears a close resemblance to three of our other species, viz., *H. cupressiforme* var. *resupinatum*, *Plagiothecium pulchellum*, and *Pylaisia polyantha*, but will hardly be confused with any other. *P. pulchellum* is known by its more opaque chlorophyllose cells, longer and more pointed, and absence of distinct angular cells; the other two plants are quite different in their erect or sub-erect, almost straight, cylindrical capsules, but when barren are more difficult to separate. *Pylaisia polyantha* has the leaves a little larger and distinctly wider below, ovate-lanceolate rather than oblong-lanceolate, but the difference can hardly be defined without the comparison of specimens; the present plant is however confined to rocks while that species almost always grows on trees and is a southern rather than a northern and mountain plant. *H. cupressiforme* var. *resupinatum* has rather larger leaves, more constantly nerveless, with the angular cells rather more clearly defined from the others; it is usually, too, a more robust plant, growing more frequently on trees, and dioicous.

17. Hypnum cupressiforme L. (*Stereodon cupressiformis* Brid., Braithw. Br. M. Fl.; *H. deflectens* Stirt. in Ann. Scot. Nat. Hist. xix, 243; *H. teichophilum* Stirt., op. cit., xvi, 177) (Tab. LIX. B.).

Extremely variable; typically moderately robust, stems procumbent, irregularly pinnate, with spreading or ascending, often curved branches; stems 2–4 inches long, rather soft in texture, scarcely radiculose, with *few, usually narrow* paraphyllia, *greenish, very rarely if ever reddish brown*. Tufts usually greyish green, yellowish, or brownish, rarely (though occasionally) bright green. Leaves closely imbricated, falcato-secund and decurved in the type (usually slightly curved in the lower half, more strongly falcate or hooked in the acumen), *rather concave and smooth*, so that the back or upper side of the stems and branches have a glossy, often rather tumid, smooth appearance, the front being quite different, with the points of the leaves bristling in the shortly acuminate forms, irregularly flexuose in the more longly acuminate, circinate or hamate forms. Leaves *oblong-lanceolate, or more or less ovate-lanceolate, rather quickly narrowed* to a fine acumen of varying length, neither much enlarged

at base nor much narrowed to the insertion, which is usually nearly straight or slightly excavate only, with minutely decurrent angles ; *plane at margin or very slightly recurved below*, typically entire, or nearly so, but frequently minutely denticulate above ; nerve none, or very shortly and feebly double ; cells narrowly linear-vermicular, rather obtuse, 10–15 times as long as wide, but often shorter and linear-rhomboid ; angular *numerous, distinct, sub-quadrate*, the greater number *small, opaque, with granular contents*, greenish, a few below these at extreme angles rather larger, pellucid, orange or hyaline, incrassate ; forming *small, clearly defined, but not inflated nor* (except rarely) *distinctly hyaline auricles*. Perichaetial bracts not plicate, denticulate. Seta 1–1½ inches long, red. Capsule usually *sub-erect, curved*, especially towards the orifice, *sub-cylindric or oblong ;* lid conical-acuminate or rostellate, rarely rostrate. Dioicous.

The variations of this common moss take the form of greater or less degrees of robustness, more or less regular pinnation, differences of colour, of the imbrication, curvature, and acumination of the leaves, the form and direction of the capsule, and other points. The principal British forms may be described as follows :—

Var. *β. resupinatum* Schp. (*H. resupinatum* Wils., mult. auct. ; *Stereodon resupinatus* Braithw., Br. M. Fl.). *Slender, the branches often almost filiform*, mostly erect or ascending, usually of a *silky*, pale or yellowish green aspect ; leaves *straight or only slightly curved, homomallous and pointing upwards or almost erect and pointing forwards, narrow, oblong-lanceolate*, entire or denticulate. Angular cells sometimes large, chlorophyllose or hyaline. Capsule *erect and symmetrical or very slightly curved or inclined ;* lid conical with a *long*, acute beak, *distinctly rostrate*.

Var. *γ. filiforme* Brid. *Extremely slender*, yellowish green, procumbent or pendent, stems long, distantly pinnate, with *long, straight, parallel, very slender, almost filiform branches ;* forming *smooth*, very low patches ; leaves *very small, very regularly and neatly imbricated in two rows, falcato-secund or hamate ;* usually denticulate. Fruit rare, small.

Var. *δ. minus* Wils. *Slender, bright green*, in more intricate tufts than the last, with more numerous, shorter, not parallel branches. Leaves *small, short ; margin distinctly recurved in the lower half*. Capsule small.

Var. *ε. mamillatum* Brid. *Slender*, more or less prostrate ; leaves regularly imbricated in two rows, *narrow, rather sharply denticulate ;* lid *conical, apiculate*.

Var. *ζ. ericetorum* B. & S. Slender, *more or less regularly and complanately pinnate ;* stems and branches often *flattened*

and sub-complanate ; very pale green, usually more or less erect or ascending. Leaves *less crowded*, strongly falcate. Angular cells distinct, often brownish in old leaves. Seta long, slender.

Var. *η. tectorum* Brid. In large, *dense*, *swollen*, *velvety cushions ;* branches stout, *erect*, *curved*, more prostrate at the outside of the tufts ; dark or olive green. Leaves *erect and closely imbricated*, *very lightly curved and secund*, more spreading when moist ; rather wide, ovate-oblong.

Var. *θ. elatum* B. & S. *Robust*, densely tufted, with few, short, *erect*, *very swollen branches ;* yellowish or golden green. Leaves *large*, *very wide and concave*, and *imbricated all round with only the points falcato-secund*, rendering the stems and branches *very tumid and julaceous ;* widely ovate-oblong, rapidly narrowed to a short oblique acumen. Fruit very rare.

Hab. Trunks of trees, walls, earth, etc. Abundant. Fr. winter and spring. Var. *resupinatum* frequent. Var. *filiforme* on trunks of trees, usually in woods, common. Var. *minus* on trees in sub-alpine woods, rare. Var. *mamillatum* on rocks and trees in woods. Var *ericetorum* on heaths and in mountainous woods, frequent. Var. *tectorum* on rocks, walls, and roofs, frequent. Var. *elatum* on the ground, in calcareous districts chiefly, frequently near the sea.

The above list by no means exhausts all our forms, but it includes perhaps the most important and the most striking. Though so polymorphous, *H. cupressiforme* has a characteristic habit and a structure peculiar to itself, so that with experience it is usually fairly easy to recognise in the field, and doubtful forms will generally reveal their identity under the microscope. The for the most part rather rapidly acuminate leaves and the characteristic, small, opaque angular cells are two of the prominent characters of distinction. It will be more convenient to point out the difference between this and the allied species under the descriptions of the latter.

The var. *resupinatum* is by many authors considered a species or at least a sub-species. In its extreme or typical form it is very distinct, and closely resembles *Pylaisia polyantha*, and, when slender and barren, *H. incurvatum*, the descriptions of which may be consulted. But it is too inconstant in its characters, or, if it be preferred, intermediate forms too closely link it with the type, to warrant this. Schimper's var. *longirostre* is exactly the same plant as regards the fruit (which is looked upon as one of the most important characters of *H. resupinatum*), and differs only in the sub-secund, decurved, not straight and homomallous leaves. I have found this variety in the same localities as the var. *resupinatum ;* but beyond this I have frequently examined plants with the greater part of the stems having the normal, falcato-secund decurved leaves of the type, but frequently throwing out slender branches with the *"resupinatum"* foliation ; more rarely stems with the straight homomallous leaves of the var. *resupinatum* will suddenly change their character in the middle, and bear in the upper half the wide, decurved, typical *"cupressiforme"* leaves. Some tufts with the perfectly erect, symmetrical capsules of the var. *resupinatum*, and beaked lids half as long as the capsule, exhibit a perfectly indiscriminate foliation, some branches being normal slender *"cupressiforme"* and others distinctly *"resupinatum"* in type. Even if all these forms be relegated to the var. *longirostre* Schp., it leaves *H. resupinatum* separated by the form and direction of the leaves alone, and as this character occurs, partially at least, in the above forms attributed to *H. cupressiforme*, it is clear that a species cannot be safely founded on this single character.

The var. *minus* is a pretty little form and is very distinct in the recurving of the margin ; it is distinct from *H. revolutum* in the texture and form of the leaves, and in the margin only recurved in the lower half, not strongly revolute almost to apex. It sometimes passes imperceptibly into var. *mamillatum*.

The var. *filiforme* is a very neat and pretty form, but all gradations may be found between this and the type. Schimper includes under this head an equally slender form with the leaves less regularly, often interruptedly imbricated, but it would appear more accurate to confine the name to the plant described above, as the very slender habit is practically the only character the two forms have in common.

The var. *ericetorum* often very closely resembles *H. imponens*, the description of which may be consulted in this connection.

The var. *elatum* is very striking, at least in its most marked forms, and quite different in its erect, tumid stems from all other states of this species. It may even closely approach *Myurium hebridarum* in size and colour.

18. Hypnum imponens Hedw. (*Stereodon imponens* Brid., Braithw. Br. M. Fl.) (Tab. LIX. C.).

Resembling *H. cupressiforme*, notably var. *ericetorum ;* differs in the following characters. Stems *more solid and rigid, reddish brown*, with *more numerous*, often *broad* paraphyllia ; more closely, regularly and *complanately pinnate ;* plants *almost always of a golden yellow ;* robust, in large tufts. Stem-leaves usually somewhat complanate, being less crowded, less concave, more spreading in the lower part, so as to render the stems flattened, in the flatter hardly channelled acumen strongly falcate or hamate ; when dry the leaves are usually somewhat rugose ; branch leaves narrower, less complanate. Stem-leaves *wider at base* than in *H. cupressiforme, triangular-oblong, more gradually acuminate*, margin usually *very narrowly recurved in the lower part*, above distinctly but somewhat distantly denticulate ; insertion wide, usually straight, not excavate nor decurrent ; median cells *longer and narrower*, basal *often bright orange*, angular less numerous but *larger, more pellucid, with scarcely any of the small opaque upper ones, forming very small, distinct auricles, usually of a rich orange brown.* Perichaetial bracts *plicate*.

HAB. Heaths, rocks, etc. ; very rare. Fr. very rare, autumn.

The orange, distinct angular cells, more pellucid and larger, the wider more strongly denticulate leaves and the general habit, as well as the more rigid, brown stems, render this plant, if not at once distinguishable in the field, at least generally easy of recognition under the microscope. Undoubtedly, however, it is linked with *H. cupressiforme* by a more or less complete chain of forms, and the characters even as given above are all either somewhat comparative or occasionally inconstant. I have for instance a plant with the general appearance of this moss, with brown stems and leaves somewhat intermediate in form, but with the angular cells typical of *H. cupressiforme ;* and forms of the latter species, especially var. *ericetorum*, unite it with the present plant. It is possible therefore that Boulay is right in making it a sub-species of that moss ; but the angular cells, which are certainly of great value in the classification of this Section, justify its separation, I think, in conjunction with the other characters. The plicate perichaetial bracts appear also to give an important character, but the fruit is too rare for this to be of practical value.

19. Hypnum Patientiae Lindb. (*Stereodon Lindbergii* Mitt., Braithw. Br. M. Fl.; *Hypnum arcuatum* Lindb., Schp. Syn.) (Tab. LIX. D.).

Resembling the most robust forms of *H. cupressiforme*, but *still larger;* stems more or less prostrate, with ascending divisions, which are usually *very slightly, often fastigiately, hardly pinnately branched,* forming large tufts or mats of a pale or yellowish lurid green, shining, *very pale and glossy at the tips of the stems and branches.* Leaves *very large* for this Section, *1 1¼ lines long,* not crowded, more or less regularly imbricated in two rows, spreading and complanate in the lower part, so as to render the stems *very broad and flattened* (less usually falcato-secund and decurved from the base, so that the stems are narrower, not complanate): *strongly hooked at the tips of the stems;* very smooth and glossy at back when dry, sometimes slightly rugose; widely ovate-oblong, somewhat narrowed and decurrent at extreme base, above tapering to a rather long, but *very broad, not slender acumen,* which is *flat,* not channelled, *abruptly pointed or even sub-obtuse;* margin plane, *entire* except at extreme apex which is sub-denticulate, nerve double, one branch longer than the other, or none; cells longer than in *H. cupressiforme,* very narrow; at basal angles laxer, then rather abruptly *large, thin-walled,* hyaline, forming *conspicuous decurrent hyaline auricles.* Dioicous.

HAB. On the ground in woods, rocks covered with earth, etc., principally on clay. Not common. Fr. very rare, not found in Britain; summer.

This plant is described in the Bryologia Britannica as a variety of *H. pratense* Koch, and it differs so little from that plant that it is somewhat doubtful whether it will not have to be ultimately re united with it. In that species the leaves, usually at least, are less hamate, only slightly decurved, so that the branches are very flattened and hardly hooked above; and the auricular cells are less distinct; but these characters are certainly inconstant. *H. pratense* has been recorded from Sussex, and is admitted by Braithwaite (as *Isopterygium pratense* Lindb.), but I think there can be no doubt that the record is an error. Davies's fruiting plant, there is good reason to believe, may have been gathered on the continent and labelled as from Sussex by a slip; while the sterile plant which I have seen, on which the second record is based, is certainly *H. Patientiae.*

The robust habit, very wide stems (taken with the leaves) and large leaves with wide, not tapering acumen and large hyaline angular cells, abundantly separate our plant from all forms of *H. cupressiforme* or its allies; indeed slender forms with the leaves less complanate and less tapering are more likely to be taken for robust plants of *H. ochraceum.*

20. Hypnum revolutum Lindb. (*Stereodon revolutus* Mitt., Braithw. Br. M. Fl.; *Hypnum Heufleri* Juratz., Schp. Syn.) (Tab. LIX. E.).

Resembles slender forms of *H. molluscum,* either erect and densely tufted with irregularly branched stems, or more prostrate

and regularly pinnate, 1–3 inches long, small ; *yellow or brownish*. Leaves crowded, *falcato-secund or hamate, small*, $\frac{1}{2}$–$\frac{3}{4}$ line long, oblong-lanceolate, *gradually tapering from near the base to a rather wide and short or sometimes longer and finer acumen*, concave, *plicato-striate, especially when dry*, entire or sub-denticulate at point, *margin strongly revolute from the base to high in the acumen ;* nerve double or obsolete ; cells variable, usually *short*, thin-walled, 4–7, rarely 6–10 times as long as broad, resembling those of *H. incurvatum*, at angles *rather numerous*, quadrate, small, rather opaque, forming *small, rather clearly defined but not very conspicuous auricles*. Dioicous.

HAB. High alpine rocks ; very rare. Ben Lawers (*Jameson, 1890*). Fruit very rare.

There can be no doubt that the plant gathered by the Rev. H. G. Jameson is identical with *H. Heufleri* Juratz., and this appears to be the same species with *Stereodon revolutus*, described by Mitten in the Musci Indiae Orientalis, 1859. If the characters italicised are borne in mind there will be little difficulty in identifying it, though this is probably impossible in the field, at least, with any degree of certainty, although in most of its forms the longitudinally plicate leaves with rather short, not circinate points are characteristic features not found in *H. hamulosum* or other species which might be confused with it. It is quite different from *H. cupressiforme* var. *minus* in the gradually tapering plicate leaves with the margin very longly and closely revolute, as well as in the habit. That species and some others frequently have the leaves somewhat rugose when dry, but here they are distinctly plicate longitudinally, and in the more robust stems this forms a marked and indeed easily recognised character.

From examination of authentic material of the N. American *H. plicatile* (*Ster. plicatilis* Mitt.) I am strongly inclined to think that it is not specifically distinct from the present plant ; and Mr. Salmon, who has compared Mitten's type specimen, is inclined to the same view. The main characters held to distinguish that species have been found to occur in some of the continental forms of *H. revolutum*. Further investigation of the American plants is needed, however, to settle the point.

21. Hypnum hamulosum B. & S. (*Stereodon hamulosus* Lindb., Braithw. Br. M. Fl.) (Tab. LIX. F.).

Very slender, resembling some delicate, dense forms of *H. cupressiforme ; bright yellow or yellowish green ;* stems *more or less erect, or ascending*, irregularly or pinnately branched. Paraphyllia very few or none. Branches very slender, with the leaves regularly imbricated in two rows, smooth and glossy at back, *strongly falcate, hooked at the tips of the stems, very small*, about $\frac{1}{2}$ line long, ovate-lanceolate, longly and finely acuminate to an almost filiform, hamate-circinate point, *entire or obsolutely denticulate*, almost or quite nerveless, *plane at margin*, concave ; areolation *rather short*, 8–15 times as long as wide, thin-walled, linear, obtuse, almost uniform throughout the leaf, *a very few at extreme angles sub-quadrate, small, not forming hyaline nor distinct auricles*. Capsule *small*, cylindrical. *Autoicous*.

Hab. Alpine rocks, rare; Scotch Highlands; N. Wales; Lake District. Fr. summer.

A delicate species, most closely allied to *H. callichroum*, but differing in its more constantly slender habit, autoicous inflorescence, shorter areolation, and, above all, in the extremely few angular cells and total absence of the inflated hyaline auricular cells characteristic of that species. It is also more constantly yellow, never bright green, and the acumen of the leaves though very fine is usually shorter, and somewhat less flexuose when dry. It differs from *H. revolutum* in the plane margin of the leaves, and from *H. Bambergeri* in the more slender habit, autoicous inflorescence, less numerous and less distinct angular cells.

22. Hypnum callichroum Brid. (*Stereodon callichrous* Brid., Braithw. Br. M. Fl.) (Tab. LIX. G.).

In wide, *very soft* tufts, more or less prostrate or ascending, *rarely erect; bright green or yellowish green*, reddish yellow within; *very glossy and even brilliant when dry*. Stems irregularly pinnate, very slender, branches more or less flexuose and curved. Leaves *elegantly circinate-secund*, $\frac{1}{2}$–$\frac{3}{4}$ line long, from a *rather dilated base*, widely oblong-lanceolate, *gradually tapering to a very long, almost filiform acumen*, which is *flexuose when dry;* plane at margin, *entire or rarely remotely denticulate*, concave, not plicate; nerve very faint or wanting; cells very narrow, *long*, linear-vermicular, *15–20 times as long as wide or more*, almost uniform to base, *at insertion often yellowish*, at angles *suddenly large, thin-walled, hyaline, forming small but very distinct, somewhat decurrent hyaline auricles;* a very few above these at margin usually quadrate, small, pellucid, with thicker walls. Capsule *rather large*, cylindrical, arcuate, horizontal. Dioicous.

Hab. Shady mountainous rocks, rare. Fr. summer.

A very beautiful species, known from all the allied species of slender habit by the clearly-defined hyaline auricular cells; but usually recognisable also in the field by its very soft slender habit, and beautiful glossy green colour, which is however not quite constant. The leaves are usually described as quite entire, but I have found them in several specimens distinctly, usually remotely, denticulate. It is a beautiful plant when well grown and in fruit conspicuous in its colouring, forming large, sometimes vivid green patches with abundant, bright orange brown capsules. A densely tufted form with branches all erect, not pinnate, has been collected on Ben Nevis and in Sutherland.

H. rupestre F. B. White, gathered on Ben Lawers in 1865, appears to belong here, according to the Rev. J. Fergusson (*Scottish Naturalist*, Vol. II., p. 279).

23. Hypnum Bambergeri Schp. (*Stereodon Bambergeri* Lindb., Braithw. Br. M. Fl.) (Tab. LIX. H.).

In dense tufts, *much more robust* than the three preceding species; stems *more or less erect*, 2–3 inches long, *rarely procumbent and pinnate, usually fastigiate with long, erect, simple branches*,

dark yellowish brown, variegated with olive green and orange; soft or rather rigid. Leaves rather large, *very regularly and elegantly circinate-secund*, when dry having the point flexuose, $\frac{3}{4}$–1 line long, from a short, widely oblong base gradually narrowed to a long, channelled, acute but hardly filiform acumen, *entire or sinuolate, plane at margin*, nerveless or with one or two faint striae; cells linear-vermicular, variable in length but *narrow, with incrassate, porose walls;* at base *usually orange;* angular *few, rather large, quadrate-hexagonal, orange, the walls strongly incrassate and porose*, forming *minute, but rather distinct orange auricles*. Fruit unknown.

HAB. Alpine rocks and earth, very rare; summit of Ben Lawers; Craig Chailleach.

In habit and general appearance this species is not unlike some of its allies; but in addition to other characters, the leaves are of a more solid texture, with porose, incrassate cell-walls, and with the angular cells few, incrassate, orange, more conspicuous than in *H. hamulosum*, but less so than, and different from those of any of the other similar species except *H. imponens*, to which they bear some resemblance; they are paler, however, and less clearly defined from the adjoining cells; and the texture, denticulate margin, etc., of the leaves of that plant, and its general habit, are widely different.

H. Bambergeri, when, as occasionally happens, it is somewhat regularly pinnate, much resembles *H. procerrimum*, and specimens of this habit, which I gathered on Ben Lawers in 1893, were indeed so named by Boswell; that species however differs in the much more regularly pinnate stems, and in the large leaves, dilated at the base, with the areolation, including that at the angles, thin-walled, not incrassate, and the angular cells numerous. In its more robust forms it bears a close outward resemblance to *H. intermedium* and *H. falcatum;* I cannot point out any character by which it may be known from the former by the lens alone; the nerveless leaves of course reveal it at once under the microscope. *H. falcatum* is known at a glance by its plicate leaves.

H. cupressiforme differs in the less circinate leaves with thin-walled areolation, and opaque, not coloured, angular cells, and other points.

24. Hypnum procerrimum Mol. (*Ctenidium procerrimum* Mol., Braithw. Br. M. Fl.) (Tab. LIX. J.).

Robust, *closely and regularly pinnate*, resembling the most plumose forms of *H. molluscum;* stems not radiculose, slightly divided, 2–4 inches long, *olive green or yellowish brown*. Leaves regularly falcato-secund, *large*, $1\frac{1}{4}$–$1\frac{3}{4}$ lines long (branch-leaves much narrower, smaller, more circinate), widely ovate-oblong from a *broad, somewhat dilated, excavate and auriculate base*, gradually narrowed to a long, tapering acumen, plane at margin and *quite entire or sinuolate only*, usually very slightly rugose or crisped when dry; nerve very short and faint, double; cells *rather short*, 8–12 times as long as broad, linear-flexuose, tapering, but not acute, *thin-walled*, at basal angles laxer and shorter, the lowest quadrate or hexagonal-quadrate, *numerous, small, opaque,*

or more rarely pellucid, slightly incrassate, forming *large, distinct, but not clearly defined*, rounded, often orange auricles. Dioicous. Fruit unknown.

HAB. Alpine calcareous rocks, very rare. Ben Lawers (*Meldrum, 1891*).

A very fine species, distinguished from its allies by the regularly pinnate, plumose stems and large leaves; from *H. cupressiforme* by the distinct, expanded, auricular leaf base with very numerous angular cells, etc.; from *H. molluscum*, which perhaps it most resembles, by the quite entire leaves of closer, firmer texture.

In the specimens from Ben Lawers, the branching is a little more irregularly and interruptedly pinnate than in continental specimens, and the stem-leaves a shade smaller and less expanded at the base, so that it has not quite so distinctive a habit for field recognition; but in the leaf structure it is quite typical; and as far as my observations go it may be distinguished in the dry state by the leaf points always more regularly falcate, less flexuose and undulate than in *H. molluscum*, which in its more robust forms, also, has the leaves distinctly striate.

25. Hypnum canariense Mitt. (*Stereodon canariensis* Mitt., Braithw. Br. M. Fl.) (Tab. LIX. I.).

Closely resembling *H. cupressiforme* except in the fruit. Stem slender, prostrate, densely pinnate; leaves crowded, strongly falcato-secund, ovate-lanceolate or oblong-lanceolate, *gradually tapering to a long, narrow, flat acumen*, not widely dilated at base above the line of insertion; margin *sharply denticulate*, especially above; nerve faint and double or none; cells long and narrow, with firm walls, not becoming distinctly laxer towards base; a few at basal angles distinct, quadrate, rather obscure, often orange. Capsule *very shortly oval*, wide-mouthed, cernuous, dark reddish-brown. Dioicous.

HAB. Rocks; Killarney (*Moore and Wilson*).

Much discussion has taken place upon the Killarney plants referred to this species (cf. Rev. Bry., 1899, 89; etc.). Wilson gathered *H. canariense* in fruit in 1829 (cf. Braithw. Br. M. Fl.), but there are I believe no specimens in his herbarium, and I have seen no fruiting British specimens. Lindberg's fruiting plant from O'Sullivan's Cascade, July, 1873, is in my opinion undoubtedly *H. cupressiforme*, of small forms of which it has the capsules, not at all the dark brown, turgid ones of *H. canariense*. All the other, sterile plants I have seen, collected by Moore, Lindberg and others, might equally in my opinion belong to *H. cupressiforme*, the var. *mamillatum* of which I believe to be separated from *H. canariense* by no distinct vegetative characters. If Wilson's fruiting plants exist they are no doubt decisive; otherwise it is I think very desirable that the fruit should be gathered in order to verify the Killarney plant.

H. canariense is most like *H. cupressiforme*, but the leaves are sharply serrulate, the angular cells fewer and less conspicuous than in the ordinary forms of that plant, and the capsule much shorter and very different, more like that of *H. molluscum*.

[*Hypnum circinale* Hook. This species was included in the 2nd ed. on the strength of certain Killarney plants referred there by Cardot. After careful investigation and comparison, however, I have been driven to the conclusion that they are not to be separated from the plant referred above to *H. canariense*, and are not identical with the N. American *H. circinale*].

26. Hypnum molluscum Hedw. (*Ctenidium molluscum* Mitt., Braithw. Br. M. Fl.; *Hypnum intortum* Stirt. in Trans. & Proc. Bot. Soc. Edin. xxvi, 246; *H. provectum* Stirt. in Ann. Scot. Nat. Hist. xi, 110) (Tab. LIX. K.).

Variable in robustness and branching. Stems *very densely tufted*, with numerous procumbent or ascending divisions, *very regularly, closely and plumosely pinnate*, or in the more erect forms densely sub-fastigiate, forming *very close, soft tufts of a glossy golden green colour*, rarely bright green or reddish. Leaves *very densely imbricated*, typically falcato-secund or flexuose and homomallous (branch-leaves narrower, often very narrow, more regularly falcato-circinate), when dry smooth or plicate, but *usually crisped and undulate, especially at the points*, giving the stems and branches a very soft, feathery aspect; usually wide at base, *cordate-triangular*, then lanceolate, tapering to a long fine acumen, at base *rounded-auriculate*, slightly decurrent, at margin plane; *distinctly and often strongly denticulate, especially at base;* nerve short and double, or none. Cells rather short and wide, 8–15 times as long as broad, obtuse, the walls firm; *gradually becoming shorter and wider at angles*, at extreme angles rather wide, irregularly quadrate-hexagonal, pellucid, but *not large, hyaline nor coloured, forming indistinct, ill-defined auricles of the same colour as the rest of the leaf*. Paraphyllia few, ovate. Seta dark purple, capsule *small, short, oval or oblong*, straight or slightly curved, dark purplish brown, *horizontal*, hardly constricted below the mouth when empty. Lid sharply pointed. Calyptra slightly hairy when young. Dioicous.

Var. β. *condensatum* Schp. In rather dense, flat tufts with *fewer, rather stouter* branches; *bright golden green*, often with a rusty tinge; stem and branch-leaves larger, *closely and regularly falcato-secund, strongly hooked at the tips of the branches, distinctly plicate when dry*.

Var. γ. *robustum* Boul. *Robust.* Stems *erect, tall, distantly and irregularly, rarely pinnately branched*, forming loose tufts frequently with a *deep vinous red* tinge. Leaves *large, regularly and strongly falcate, plicate*, especially when dry, *glossy*.

Var. δ. *fastigiatum* Bosw. (*Hobkirk, Syn. Ed. II*). *Very slender*, branches *erect, less closely pinnate, somewhat fastigiate;* leaves *less crowded, small, less strongly falcate*.

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Hab. Calcareous soil and mountain rocks by streams. Common. The vars. β, γ on mountain rocks by streams, less common ; the var. δ, very rare. Fruit summer.

H. molluscum although somewhat variable has a look of its own which is generally easily recognised ; the soft dense tufts, very closely and regularly pinnate, with the leaves very densely imbricated, flexuose and undulated at points, principally contribute to this. Under the microscope the strongly denticulate, broadly cordate stem-leaves with the angular cells somewhat enlarged but otherwise hardly different from the rest of the areolation, readily separate it from its allies. For its relationship to *Hyocomium flagellare*, see the description of that plant.

Schimper separates this species under the sub-genus *Ctenidium*, retained as a genus by Lindberg and others, partly on account of the shortly ovate-wide capsule of solid texture ; but although this is often a marked feature, it also frequently happens that the capsule is longer, longly if widely oblong, and sometimes arcuate, while the texture is sometimes, at least, less solid ; in short, in no way differing from some forms of *H. cupressiforme* and other allied species.

The end walls of the cells not unfrequently project in minute points at the back of the leaf, forming scattered, acute, very small papillae.

The var. *fastigiatum* is a very marked, slender form, of a dull, olive green in the specimens I have seen ; it does not appear to be the same form as the var. *erectum* of Schimper, which is tall, pinnate, and with the branch-leaves less finely acuminate. Our variety, first found in Derbyshire, was originally referred to *H. canariense* Mitt.

The vars. *condensatum* and *robustum* agree in the strong tendency to take on a deep vinous red tint, and in the regularly falcate, plicate leaves ; but the habit and branching of the latter variety is very distinct, and does not at all agree with the description given by Schimper of his var. *condensatum*. I have thought it best therefore to keep them apart, but it must be pointed out that they pass into one another by intergrading forms. The var. *robustum* in its best marked, alpine forms is a striking and beautiful variety ; I should unite with it the var. *croceum* (*H. croceum* Tayl.).

An extremely pretty variety which I have from Killarney and one or two Perthshire localities has very slender erect stems and branches, as in var. *fastigiatum*, but it is of a paler colour and has the small leaves all very regularly and neatly falcate in a striking manner. It may possibly belong to Schimper's var. *erectum*, or if not, is deserving of a varietal name.

Another form occurs on the limestone in the Derbyshire Dales, with the stems prostrate and the branches erect, the leaves not at all secund, but rigidly squarrose, in form and direction very much like those of *H. hispidulum* var. *Sommerfeltii*, for which indeed it has been more than once mistaken. It may be the var. *squarrosulum* Boul., but the habit does not quite agree with the descriptions of that plant.

27. **Hypnum crista-castrensis** L. (*Ptilium crista-castrensis* De Not., Braithw. Br. M. Fl.) (Tab. LIX. L.).

Tall, *very robust ;* stems *erect, or ascending*, simple or twice or thrice divided, 3–5 inches long, *very regularly and beautifully pinnate with dense, complanate branches, giving a strikingly regular, plumose appearance to the plant ;* in large loose tufts or masses of a *bright yellowish green*, pale below. Branches almost equal in length except at the summit of the stem, where they gradually diminish like the pinnae of a fern, hooked and shining at the tips. Stem-leaves crowded, *very wide, thin and membranous, whitish ;*

from a *wide, rounded-oblong, erect, strongly plicate base* gradually acuminate to a slender, hamato-secund, tapering point; decurrent, remotely denticulate above; cells *very narrow, vermicular*, incrassate, 10–20 times as long as broad, angular wide, pellucid, *not very distinct*. Paraphyllia *numerous*. Branch-leaves much narrower, less deeply plicate, strongly circinate, usually in the same plane as that of the frond. Seta long, 1½–2 inches; capsule large, horizontal, arcuate. Dioicous.

HAB. On rocks and earth in mountainous woods, principally of conifers; rare. North of England; Scotland. Fruit rare, summer.

This splendid species, indisputably one of our most beautiful mosses, though rare with us is usually most abundant in the spots where it is found, growing among mosses and other plants, and very striking and conspicuous. Even in its most stunted forms it is more regularly and equally pinnate than *H. molluscum*, and quite distinct in its stem-leaves. The densely pinnate branches are rendered the more close in appearance by the fact that the leaves of each branch are usually curved towards the succeeding lower branch, in the same plane with the whole frond, thus filling the spaces between the branches; in most of the allied species, which are less erect, the downward curving of the leaves places them more at right angles to this plane, and the branches are therefore more remote in appearance, even if not much more so in actual distance.

D. LIMNOBIUM.

Plants procumbent, rarely erect, almost always growing on wet rocks, principally on mountains; hardly ever in bogs, rarely on wood. Leaves short and wide, of soft, flaccid texture, obtuse, rounded and apiculate, or shortly pointed, rarely shortly acuminate and acute. Nerve double or forked, in some species at times single and reaching high in the leaf.

The leaves are generally more or less secund and falcate, though rarely strongly so; almost entire, though in some foreign species, *e.g.*, *H. montanum* Wils., regularly denticulate; and in their general form and texture very distinct from those of the other Sections, in the latter respect especially from those of Calliergon, which otherwise they most resemble. The form of leaf and the character of the angular cells are of the greatest importance for their determination.

The species may be briefly tabulated according to the character of these angular cells, as follows, omitting *H. scorpioides*, which is very distinct in its robust, tumid habit, and very large, and, when dry, rugose leaves.

Angular cells thin-walled, large, hyaline, forming distinct, not inflated, decurrent auricles ..... *H. ochraceum*

Angular cells more incrassate, large, pellucid, hyaline or rich orange-brown, forming very distinct, inflated auricles
H. eugyrium

Angular cells more or less incrassate, granulose, not hyaline, forming ill-defined, more or less opaque or orange auricles
H. palustre, H. arcticum, H. molle, H. dilatatum.

1 { Ls. large, roundish, swollen on one side ; nerveless or shortly 2-nerved *33. scorpioides*
{ Ls. not swollen on one side, usually smaller.....2

2 { Ls. widely ovate or roundish, apex usually obtuse or apiculate.....3
{ Ls. ovate or ovate-lanceolate, more or less tapering towards apex.....5

3 { Ls. about ¼ line long, roundish.....*30. arcticum*
{ Ls. about 1 line long.....4

4 { Ls. widely ovate, slightly tapering to bluntish points, soft.....*29. molle*
{ Ls. sub-orbicular, firmer, sub-secund.....*29*. dilatatum*

5 { Angular cells large, thin, hyaline ; dioicous.....*32. ochraceum*
{ Angular cells more or less incrassate, or opaque.....6

6 { Angular cells pellucid, usually orange ; nerve faint, double...*31. cuspidatum*
{ Angular cells obscure, granulose ; nerve single or double.....*28. palustre*

28. Hypnum palustre Huds. (*Amblystegium palustre* Lindb., Braithw. Br. M. Fl.) (Tab. LIX. M.).

Very variable, usually slender, frequently more robust, variously coloured, dark green, reddish, or dull yellowish green, *rarely bright green*. Stems more or less prostrate, usually much denuded at the base ; branches usually more or less numerous, erect or ascending, often curved, or hooked at the tip ; forming low, usually irregular and untidy patches. Leaves very variable, *imbricated all round the branches, rendering them julaceous, or more frequently secund, often distinctly and sometimes strongly and regularly falcate, always concave, with the margins incurved especially towards the summit*, so that the leaves can never be flattened out without tearing ; more or less *oval-oblong*, ½–¾ lines long, very variable above, rounded and obtuse or apiculate, or more frequently tapering (especially in the secund forms) to a longer or shorter obtuse or acute point, but never narrowly and longly acuminate, and usually very short and sub-obtuse ; decurrent at base, *entire at margin ;* nerve very variable, usually single and forked, reaching about half way, frequently longer and unbranched, nearly attaining the summit, less commonly very short, faint and double. Areolation rather lax, short, linear-rhomboid or linear and flexuose, rather opaque, 5–10 times as long as wide, rather shorter at point, becoming slightly laxer at base, angular *few, quadrate, moderately large, but somewhat opaque with granulose contents, not very pellucid, nor hyaline*, forming *small, ill-defined and inconspicuous auricles*. Perichaetial bracts *entire*. Seta ½–¾ inch, rarely 1 inch. Capsule oblong or oval-oblong, rather short, thick and irregular, horizontal, dark red ; annulus *none*. *Autoicous*.

Var. β. *hamulosum* B. & S. Slender; leaves *regularly falcato-secund; oblong-lanceolate, more or less tapering;* nerve *short, double;* capsule oblong, narrow, curved.

Var. γ. *subsphaericarpon* B. & S. (*H. subsphaericarpon* Schleich.). Robust; stem longly denuded; leaves *large, widely ovate, tapering,* secund or falcato-secund; nerve *strong, single, reaching high in the leaf.* Capsule *short, widely oval, turgid.*

HAB. On rocks in and by streams; rarely on wood by water. Common in subalpine regions. The vars. β, γ, less common. Fr. summer.

The most widely distributed and common of this Section, and the most variable; it is the only one which is found at all commonly outside mountainous districts. There are two distinct groups into which its varied forms may be separated, one with the leaves widely ovate, hardly tapering, obtuse or apiculate, imbricated all round the stems so as to render them julaceous, not or hardly at all secund (laxer and denser forms of this group are described under the names of var. *laxum* B. & S. and var. *julaceum* B. & S.); the other with the leaves more or less tapering above to an obtuse or more rarely acute point; to this group the two varieties described belong. The var. *subsphaericarpon* must be considered to depend chiefly on the form of its fruit, for the same form of leaf with long single nerve is frequently found associated with the longer, more typical capsule, while on the other hand very short, turgid capsules are not always accompanied by the long single nerve. I have seen many British plants with the nerve exceedingly stout and long, but have seen no capsules quite equal to the large, turgid ones which I have gathered on the continent.

The fruit is common, and the want of annulus, and autoicous inflorescence will separate *H. palustre* from several of its allies; but as some of these are rarely found in fruit it is of more importance to point out the vegetative characters of distinction. The habit and the indistinct auricular cells will separate it at once from all but *H. arcticum, H. molle* and *H. dilatatum;* these all have wider, almost rounded leaves, which are however a little narrower in *H. molle,* and this is really the only species which might be confused with *H. palustre;* the former however is always of softer, flaccid texture, the leaves wider, never narrowly tapering, nor secund, usually a little denticulate at summit, the perichaetial bracts distinctly so. Probably the widest leaves of *H. palustre* are narrower than in *H. molle,* and are always entire.

I have occasionally but very rarely seen forms with the angular cells very distinct and highly coloured, simulating those of *H. cuspidatum;* in these cases the nerve and form of leaf will usually serve to distinguish them.

29. Hypnum molle Dicks. (*Amblystegium molle* Lindb., Braithw. Br. M. Fl.) (Tab. LIX. N.).

Stems sparingly divided, often denuded at base, branches ascending or procumbent, *tumid, obtuse;* forming *low, lurid, brownish tufts of very soft and flaccid texture.* Leaves rather large, ¾ line long, spreading or erecto-patent, not densely crowded, *not secund nor falcate, very soft,* concave, *widely oval, slightly narrowed above the middle to a very broad, rounded, obtuse apex, narrowed at base, obsoletely denticulate at tip,* nerve bi-trifid, very short and faint, rarely one branch longer and reaching the middle of the leaf. Cells linear, flexuose, 10–15 times as long as wide;

at angles resembling those of *H. palustre*, slightly more distinct, forming inconspicuous and ill-defined auricles. Perichaetial bracts *denticulate above*. Autoicous.

Var. β. *Schimperianum* Schp. (*Hypnum Schimperianum* Lorentz). *More slender*, in dense swollen tufts; leaves *much smaller, more shortly* pointed, the auricles less distinct.

HAB. Alpine rocks in streams, very rare. Ben Nevis; Ben MacDhui; Cairngorm. The var β, Loch-na-gar (*Fergusson*). Fr. summer.

H. molle forms very soft, easily separating tufts, and by this and the broad, rounded leaves may be known from *H. palustre* and *H. arcticum*, the only distinct species with which it is likely to be confused, except *H. ochraceum*, which has often the same soft texture, but which has almost constantly narrower, more tapering leaves, and is always known by the distinct hyaline auricles. The differences between it and *H. dilatatum* are pointed out below. When growing in water it sometimes produces large, soft, much interwoven mats quite different from its usual growth.

The var. β is a slender form, with a different habit, but the characters are superficial rather than structural.

* **Hypnum dilatatum** Wils. (*Amblystegium dilatatum* Lindb., Braithw. Br. M. Fl.) (Tab. LX. A.).

Closely allied to *H. molle*, but *more rigid*, of a dull green rather than brownish colour; the leaves *slightly secund, or homomallous, wider, sub-orbicular, hardly narrowed from the middle*, but rounded-obtuse at the summit, sometimes with a short, obtuse apiculus; cells *longer*, especially in the lower half of the leaf, 15–25 times as long as wide, the angular rather larger and more distinct, *frequently orange*.

HAB. Rocks in mountain streams, very rare. Fr. summer.

The characters italicised above will readily indicate the distinguishing characters of this plant from *H. molle*, its nearest ally; Boulay, indeed, makes it a variety of that plant, but the characters appear of a certain weight though hardly sufficient to support its separation as a species. It is a more difficult question which of the two plants should be considered the type and which the sub-species; *H. molle* was the first described; on the other hand *H. dilatatum*, on the continent especially, is much the most widely distributed.

H. arcticum differs in the still more rigid habit, smaller leaves, shorter cells, and longer, single nerve.

30. Hypnum arcticum Sommerf. (*Amblystegium Smithii* Lindb., Braithw. Br. M. Fl.) (Tab. LX. B.).

Resembling a small form of *H. dilatatum; slender*, branches more or less erect or ascending, *rigid*, forming *firm, compact patches of a dull rusty brown*, blackish within; stems denuded below. Leaves imbricated all round the stem, *not secund, very small*, hardly ¼ line long, *sub-orbicular or very widely oval*, rounded

and obtuse or very broadly and obtusely pointed at summit, concave, *minutely, almost imperceptibly denticulate at margin*, nerve *usually single, stout, reaching about half-way*, more or less; more rarely short and double. Cells *very short, incrassate*, the median linear-elliptic, flexuose or sigmoid, obtuse, 4–6 times as long as wide, at margin and apex shorter and more opaque, those at apex shorter and very wide, ovate-rhomboid; angular very few, incrassate, sub-rectangular, opaque, forming very small and indistinct, usually orange auricles. Capsule small, short, horizontal. Autoicous.

HAB. Wet rocks and in streams on high mountains; very rare. Ben Lawers; Ben Chalum; Canlochan; Clova. Fr. summer.

A distinct and extremely rare species, quite different in the form of its leaves from all but *H. molle* and *H. dilatatum*; from these the size of the leaves alone at once distinguishes it, apart from the long nerve, short cells, rigid habit, etc.

31. Hypnum eugyrium Schp. (*Limnobium eugyrium* B. & S.; *Amblystegium eugyrium* Lindb., Braithw. Br. M. Fl.) (Tab. LX. C.).

Stems prostrate, branches numerous, erect or ascending or procumbent, forming low dense tufts, rather firm and compact, bright green or reddish, often variegated with brown and yellow, glossy. Leaves rather widely spreading when moist, *more or less secund*; more erect when dry, but loosely imbricated and concave, rendering the branches turgid; *oval-oblong, shortly narrowed to a rather rounded apex with a more or less abrupt, straight, acute, rarely obtuse apiculus*; narrowed but not rounded at base; *very concave, often incurved at margin above*, entire or minutely denticulate at apex; nerve short, faint, double; cells rather short, linear, obtuse or pointed, thin-walled, 8–10 times as long as wide; remaining uniform to base, short at the extreme apex; at angles *suddenly large, inflated, the inner incrassate, the outer thin-walled, hyaline, or rich orange-brown*, forming *very clearly-defined, distinct, slightly inflated auricles*. Perichaetial bracts denticulate at apex. Capsule short, oval or oblong, inflated; annulus present. Autoicous.

Var. *β. Mackayi* Schp. *More robust*, less soft. Leaves imbricated all round the stem, *scarcely secund*, larger; *auricles less clearly defined*.

HAB. Rocks in mountain streams, not common. The var *β* in similar situations, and apparently as widely distributed. Fr. summer.

The very clearly defined, small, highly coloured auricles at once distinguish this species; on the young leaves they are hyaline, but soon, the inner ones at first, become orange, gradually deepening in colour until in the older leaves

they are of a rich sienna hue and quite opaque with the colouring matter, though free from granular contents. The leaves too are very constant in form, and the apiculate summit is very characteristic. The var. *Mackayi* does not appear to be very clearly marked off from the type, the characters given being none too constant. The less clear definition of the auricles does not, at any rate always, arise from the cells being smaller, but from the intervention of one or two series of obscure, inerassate, more or less coloured cells which form a more graduated step from the rest of the leaf-tissue. In its tall forms this variety bears a considerable resemblance, when growing, to *Brachythecium plumosum*, with which it is frequently mixed, but the shortly pointed leaves can be easily recognised with the lens.

32. Hypnum ochraceum Turn. (*Amblystegium ochraceum* Lindb., Braithw. Br. M. Fl.) (Tab. LX. D.).

Very variable, often simulating species of the Section Harpidium, or others of the present Section. Stems prostrate, 2-4 inches long, with irregularly pinnate, few, ascending or procumbent parallel branches, rarely more erect and curved, *soft and flaccid*, in dense large tufts, *pale green*, *usually with a yellowish colour*, rusty red, or deep brown, most frequently yellowish. Leaves sub-secund, *usually strongly falcato-secund*, concave, *more or less widely oblong-lanceolate* from a slightly rounded base, *tapering to a longer or shorter, wide, obtuse or sub-obtuse acumen*, which is often somewhat twisted; lightly plicate, entire, except at the minutely denticulate apex; nerve variable, short and double or single and reaching half way or more. Cells linear-vermicular, narrow, 8-15 times as long as wide; angular *very large, thin-walled, hyaline*, forming *rather well-defined and large, very conspicuous, hyaline, decurrent auricles*. *Dioicous*.

Var. β. *flaccidum* Milde. Leaves *straighter, not falcate*, not or hardly secund; *narrow*, longly or shortly acuminate, often complanate; slightly flexuose when dry.

HAB. Rocks in mountain streams, frequent in mountain districts. The var. β rare. Fr. summer, very rare.

A polymorphous plant, mostly resembling forms of *H. palustre*, but usually longer, softer, and more brightly coloured; and quite distinct in the large hyaline auricular cells, which, with the form of the leaf will also distinguish it from the other allied species. Its soft, flaccid texture is a fairly constant and reliable character.

The fruit is rarely found, and the fertile plant is usually of a duller colour, and shorter, more compact growth, often much embedded in sand.

Under var. β I unite both vars. *flaccidum* and *complanatum* Milde; the latter is distinguished by having the leaves more distinctly complanate, and with shorter points; but with us these two forms grow together and pass into one another at times, nor at the best are their differences great. This variety is mostly found in the streams of northern England.

33. Hypnum scorpioides L. (*Amblystegium scorpioides* Lindb., Braithw. Br. M. Fl.) (Tab. LX. E.).

Very robust, rarely somewhat slender; stems procumbent, with *very long, almost simple or slightly branched divisions*, erect, ascending or procumbent, 4–6 inches long, *very tumid with the imbricated, large leaves*, forming large soft masses of a variegated yellowish or brownish green, very often passing to reddish purple or almost black. Leaves loosely or closely imbricated, *more or less homomallous or falcato-secund, very large*, 1–2 lines long, *rugose and undulated whendry*, widely ovate-oblong, usually *asymmetrical*, one margin being more convex than the other, gradually widened above the rather narrow but not rounded base, above *shortly and widely narrowed to an obtuse or apiculate point*, or more gradually and longly, but very broadly tapering, very rarely somewhat longly acuminate with a slender denticulate apiculus; *very concave, entire* (except in the above condition), nerve very faint, usually short and double; cells very long and narrow, linear, about 15 times as long as wide, the walls incrassate and porose; *almost uniform to base, a few at insertion wider, pellucid, sub-rectangular;* special angular cells *none or very few*, inflated, pellucid or orange, forming minute but well-defined, not decurrent auricles. Thin hyaline cells detached from the stem frequently, however, give the appearance of decurrent auricular cells. Seta very long; capsule rather large, horizontal, oblong, curved. *Dioicous*.

HAB. Bogs and submerged rocks on mountains, not uncommon. Fr. rare, summer.

In its typical form readily known by its deep reddish colour, tumid stems and branches, and large, obtuse or shortly pointed, rugose leaves; it somewhat resembles *H. Wilsoni* and *H. lycopodioides*, especially when the leaves are more tapering and acute; it will be found however on careful examination that the acumen is usually more or less channelled or involute at the margins, so as to appear, especially when dry, narrower than is really the case; in the very few cases when the point is really so long and narrow as to be hardly distinguishable from *H. lycopodioides*, the colour is as a rule distinctive; if not the short double nerve and absence of large decurrent auricles will at once identify it under the microscope. The cells are most frequently uniform all along the straight, truncated line of insertion; but not unfrequently there are a very few large hyaline or coloured cells at the extreme angles above this line, forming true, but very minute auricles.

The position of this species is somewhat doubtful; its affinities with *H. lycopodioides*, etc., are obvious; yet the usually obtuse leaves, and the short double nerve are characters of some importance when considered in connection with the Section Harpidium, in which a single, long nerve and fine acumen is so constant and characteristic.

In colour and habit, especially in slender forms, there is also frequently a resemblance between the present plant and *H. revolvens*. The secund leaves and absence of differentiated angular cells separate it from *H. turgescens*. It varies a good deal in size, in the leaves sometimes very narrow and acuminate (var. *angustifolium* San.), in colour, and in other points.

A remarkable form was gathered by the Scotch Lake Survey at the bottom of L. Peerie, in the Orkneys, having comparatively thin-walled cells, scarcely porose at base, with the cell-walls somewhat projecting at the ends and with one or two rather large papillae on the lumen of many of the cells.

E. CALLIERGON.

Plants usually tall and erect, often slender, usually slightly branched. Leaves rarely secund, mostly large, broad, obtuse or apiculate merely, glossy. Usually growing in bogs or on the ground, rarely on rocks.

1 { Ls. single-nerved.....2
  { Ls. nerveless or shortly 2-nerved.....7

2 { Stems and branches turgid with the large concave leaves...*36. turgescens*
  { Stems and branches not or scarcely turgid.....3

3 { Ls. imbricate when dry; stem almost simple.....4
  { Ls. scarcely imbricate; stem more or less branched.....5

4 { Ls. roundish, very obtuse, brownish; auricles indistinct...*35. trifarium*
  { Ls. oblong, green or yellowish; auricles distinct.....*34. stramineum*

5 { Ls. more or less oblong, usually apiculate, older ls. red...*39. sarmentosum*
  { Stem-leaves wide, cordate-ovate, obtuse, usually green.....6

6 { Branches few; auricles not distinctly marked.....*37. cordifolium*
  { Branches numerous; auricles distinct and swollen.....*38. giganteum*

7 { Stem green or reddish brown; branches cuspidate; ls. with hyaline auricles .....*40. cuspidatum*
  { Stem bright red; ls. with yellowish auricles.....*41. Schreberi*

34. Hypnum stramineum Dicks. (*Amblystegium stramineum* De Not., Braithw. Br. M. Fl.) (Tab. LX. F.).

Slender; stems erect or ascending, not denuded at base nor radiculose, *simple or slightly divided;* divisions straight or flexuose, *very slender, simple or with very few branches, terete, soft and weak; pale green or yellowish, 3–8* inches high. Leaves rather close, more or less erect and imbricated, concave, decurrent, ¾–1 line long, *ovate-oblong or oblong, widest near the base,* obtuse, rounded and sub-cucullate at summit, not unfrequently producing tufts of brown radicles at apex, entire, lightly plicate; nerve single, slender, reaching to near the apex; cells widely linear or linear-rhomboid, thin-walled, 8–15 times as long as wide, a *small patch in the middle of the apex short, rounded-quadrate;* wider at base, at angles suddenly much enlarged, thin-walled, hyaline, forming *very distinct, hyaline, decurrent auricles.* Seta very long, slender. Capsule oblong-cylindric, curved, oblique, tapering at base; annulus none. Dioicous.

Hab. Mountain bogs, and marshes, rare. Fr. very rare, summer.

Known by its slender, almost unbranched, terete stems, often intermingled with other mosses in bogs, and looking somewhat like weak, slender forms of *H. cuspidatum*, but not cuspidate and acute at the tips as in that species, and quite distinct in the single-nerved leaves. *H. trifarium* is very distinct in its rigid, brittle, more turgid stems with much wider leaves; *H. sarmentosum* usually in the very different colour, the more branched stems, frequently apiculate leaves, etc.; *H. cordifolium* in the much wider leaves with large cells.

35. Hypnum trifarium W. & M. (*Amblystegium trifarium* De Not., Braithw. Br. M. Fl.) (Tab. LX. G.).

More robust than the last; stems *prostrate or procumbent, rigid and very brittle, more turgid and julaceous*, of a *golden or dark brown colour*. Leaves closely and very regularly, somewhat spirally imbricated, in 3 or more rows, often appressed when dry so that the stems are terete and cylindrical, when dry glossy, frequently very finely and delicately striate longitudinally; very concave, *widely ovate or sub-orbicular, widest about the middle*, very obtuse, nerved to or beyond the middle, entire; cells linear-vermicular, somewhat incrassate, obtuse, 10–15 times as long as wide, not distinctly shorter at apex; all basal large, lax, hyaline, *hardly distinct at angles*. Dioicous.

HAB. Deep mountain bogs and pools; very rare; Scotch Highlands. Fr. extremely rare, not found in Britain.

A very distinct species; in the leaves somewhat resembling *H. dilatatum* but quite distinct in the habit, colour, and brittle texture, as well as in the single nerve. The leaves are much wider than in the last species, and indeed the resemblance between the two plants is not very great. It resembles *H. turgescens* more closely, but that plant differs in the erect, very tumid, not rigid stems, the basal areolation, etc. The leaves are so concave that they almost always split from the apex downwards on being flattened.

36. Hypnum turgescens Schp. (*Amblystegium turgescens* Lindb.) (Tab. LX. H.).

In tall dense tufts, olive green or reddish. Stems 3–6 inches high, *robust*, erect, little branched, *soft, not rigid nor brittle;* stems and branches *tumid with the large, closely set, loosely or closely imbricated*, erect or spreading, not secund leaves, obtuse at tips. Leaves large, *widely ovate-oblong, very concave, cucullate at apex, obtuse or with a minute recurved apiculus*, slightly auricled and excavate at base; margin entire; nerve *short*, about $\frac{1}{3}$ length of leaf, feeble, bi-trifid above. Upper cells rather wide and short, elliptical-linear, 5–8 times as long as wide, with firm but not much incrassate walls; gradually becoming longer towards base with the walls increasingly thickened and porose; basal cells linear-rectangular, walls very incrassate and strongly porose, at angles *rather numerous, wide, rectangular, obscure*, forming indistinct, not inflated auricles. Dioicous. The fruit is known from two localities only, in Sweden.

Hab. Mountain bogs, very rare. Ben Lawers (*Binstead, 1902*); Cader Idris. The fruit is known from two localities only, in Sweden.

A fine and distinct species, the systematic position of which is not quite clear, but it appears best placed in this Section near *H. trifarium*. It is quite distinct however in texture, in the less orbicular, cucullate leaves, with enlarged angular cells. *H. scorpioides* differs in the secund leaves; the other species in this Section either in the much less tumid stems with less concave leaves or in the much longer nerve.

Its recent discovery in Britain is especially interesting because it was a native of our islands in Pleistocene times, and supposed to have become extinct. Dr. Nathorst discovered it in 1872 in the Arctic Freshwater Beds from a well at Mundesley, Norfolk, in company with *Salix polaris*; and I recently detected it in some quantity in material from the same beds, with *H. capillifolium* Warnst., *H. Richardsoni* (Mitt.), etc.

It has been happily discovered in a second locality, when the Brit. Bryol. Soc. met at Dolgelly in 1922; it was not recognised at the time but some stems of it were later detected by Rev. R. Jackett among bog mosses gathered on the side of Cader Idris.

The fruit nearly resembles that of *H. sarmentosum*.

37. Hypnum cordifolium Hedw. (*Amblystegium cordifolium* De Not., Braithw. Br. M. Fl.) (Tab. LX. I.).

Tall, 4–8 inches, slender; stems more or less erect or procumbent, with erect divisions which are long, *almost simple or distantly and very irregularly pinnate*, cuspidate at the tips; forming deep, soft tufts of a *bright or yellowish green*. Leaves *distant, erecto-patent or spreading*, soft in texture and somewhat shrinking when dry; *large*, 1–2½ lines long, wide, cordate-oval or ovate-oblong, rounded and contracted to a longly decurrent insertion, slightly concave, rounded-obtuse and often cucullate at summit, entire, not plicate; nerve single, reaching nearly to apex, *slender*, but distinct; cells large, 100–160 μ long, 8–10 μ wide, linear-sub-hexagonal, pointed, thin-walled, a few at apex short and wide; *gradually wider towards base, all basal large, wide, more or less pellucid*, hexagonal or rectangular, *forming wide, decurrent bands reaching to the nerve, not well-defined auricles*. Seta 2–3 inches long, flexuose. Capsule rather large and turgid, oblong, curved. *Autoicous*.

Hab. Marshes and pools, not common. Fr. rare, summer.

Somewhat variable in size and robustness, its slender forms coming near in appearance to forms of *H. cuspidatum* and of *H. riparium*, but quite distinct from the latter in the obtuse leaves, from the former in the more distant, single-nerved leaves. *H. giganteum* differs in the numerous, crowded branches, the colour usually deeper and more lurid, and the narrower areolation, with the auricles very distinct.

A continental and N. American plant, *H. Richardsoni* (Mitt.) Lesq. & James (*H. Breidleri* Juratz.) is somewhat intermediate between these two species, having the autoicous inflorescence and slender nerve of *H. cordifolium*, which it most resembles in the habit, but with the areolation of *H. giganteum*. I have found fragments, which Renauld agrees with me in referring to *H.*

Richardsoni, in the pleistocene deposits from Mundesley mentioned under *H. turgescens*, and in all probability the same plant in similar beds from the Thames valley. The specific value of *H. Richardsoni* is however very doubtful, as the characters are ill-defined, and both the inflorescence and cell structure are variable and unstable in the allied plants.

38. Hypnum giganteum Schp. (*Amblystegium giganteum* De Not., Braithw. Br. M. Fl.) (Tab. LX. J.).

Allied to *H. cordifolium ; more robust, with very close, numerous, pinnate, not complanate branches*, which are irregular in length, obtuse or cuspidate, usually with very narrow leaves ; in dense tufts of a *dark, lurid green*, often tinged with yellow or red. Stem-leaves large, more rigid and glossy when dry, resembling those of *H. cordifolium*, but rather larger, firmer, *more crowded ;* cells *narrower in proportion to their length*, about 7 μ wide, linear-flexuose, less enlarged towards base ; *at extreme base suddenly enlarged, hyaline, inflated, forming large, well-defined, decurrent auricles extending almost to the usually wider nerve. Dioicous.*

HAB. In similar situations with the last ; not common. Fr. very rare, summer.

The very dense, pinnate branching gives the plants a very robust and bushy appearance, quite distinct from that usual in *H. cordifolium ;* somewhat slender and less branched forms occur, however, and then the well-defined auricles and narrower upper cells are the best identifying points. The difference of areolation does not consist so much in the upper cells being much wider in *H. cordifolium*, for although larger generally they are not much wider in proportion to their length, though with thinner, less firm walls, and less vermicular ; but in that species the areolation becomes very wide and lax throughout the whole width of the leaf at some distance above the base, passing very gradually into the large, hyaline, decurrent tissue, while in this the cells, though wider and shorter towards base, are much less markedly so, and pass abruptly into the inflated, hyaline auricles. Both species however show some variation in this, as well as in the width and size of the upper cells. The inflorescence too is not perfectly reliable, since plants of *H. cordifolium* may occasionally be found with male flowers alone in at least some stems.

In one form of the present plant the stem-leaves, especially the upper ones, are elongated and narrowly tapering, with the margins at point much enrolled when dry so that they have a very tapering, pointed appearance. The leaves occasionally produce radicles from the apex as in *H. stramineum*.

39. Hypnum sarmentosum Wahl. (*Amblystegium sarmentosum* De Not., Braithw. Br. M. Fl.) (Tab. LX. K.).

Resembling *H. cuspidatum* in habit, but more distantly and irregularly, *not pinnately branched*, and of a totally different colour, *deep purplish crimson*, sometimes variegated with green and orange ; the apex of stems and branches frequently but not at all regularly cuspidate with convolute leaves ; the leaves *less rigid*, irregularly spreading or loosely imbricated, *when dry somewhat flexuose*, elliptic-lanceolate or narrowly oblong, narrowed

at base, rounded and cucullate at apex, obtuse, or shortly apiculate, entire, *nerved nearly to apex ;* cells narrow-linear, slightly incrassate, 10–15 times as long as wide, towards base very slightly wider, linear-rectangular, with the walls thicker and porose ; at insertion wider, shorter, sub-rectangular, very incrassate ; at angles suddenly larger, the inner incrassate, orange-brown, the outer still larger, thin-walled, hyaline or coloured ; forming *well-defined, rather large, hyaline or orange, decurrent auricles*, reaching nearly to the nerve. Capsule rather small. Dioicous.

HAB. Mountain bogs and streams, not common. Fr. very rare, summer.

Recognised at once by its colour and general habit, and not very variable. I have seen no description of the var. *sub-flavum* Ferg., but the specimens I have of that variety appear to be characterised only by the pale, orange colour, the soft texture, and the leaves somewhat more widely spreading and flexuose when dry. It is probably only a weak, semi-aquatic state. The var. *molle* Holt, from a specimen of Holt's (perhaps the original gathering), Clogwyn-du-Arddu, Sept., 1883, seems scarcely distinct from the above.

Occasionally the stems are procumbent with the tips curved upwards and the leaves sub-secund. It is then sometimes turgid and very robust. The only form which is likely to cause any difficulty is a slender, perfectly green form (var. *fallaciosum* Milde) which I have gathered on one or two mountains in Scotland. It may then be easily taken for *H. stramineum*. Usually there is sufficient tinge of purple on one or other part of the plant to distinguish it, but in the very rare cases where this is absent it may be known by the less widely rounded leaf-apex, without a distinct group of rounded cells, and also by the auricles which reach nearly to the nerve, while in *H. stramineum* there is a considerable space next the nerve occupied by the median linear cells. The upper cells in this form are much less incrassate than in the type, and are scarcely different from those of *H. stramineum*.

40. Hypnum cuspidatum L. (*Acrocladium cuspidatum* Lindb., Braithw. Br. M. Fl.) (Tab. LX. L.).

Tall, moderately robust ; stems rigid, green or reddish brown, erect or ascending, *more or less regularly, hardly complanately pinnate*, forming loose tufts of a *bright or yellowish glossy green* or golden brown. Stems and branches *at the tips tercte and cuspidate with the convolute apical leaves ;* stem-leaves sheathing, with or without the points spreading, or erecto-patent from the base, crowded, scariose, 1–1¼ lines long, widely elliptic-oblong, broadest at the base, narrowing upwards to a broad, rounded, obtuse, concave-cucullate apex ; branch-leaves narrower, more divergent or spreading, oblong-lanceolate, somewhat pointed ; all entire, *nerveless or with two very short, faint nerves ;* areolation very dense and narrow, the cells linear-vermicular, very narrow, 15-20 times as long as broad, almost uniform throughout the leaf ; at basal angles *suddenly expanded*, very large, hexagonal, thin-walled, hyaline or orange, inflated, forming *very clearly defined, large decurrent auricles*. Seta very long, 1½–2½ inches ; capsule large, sub-cylindric, strongly arcuate. Dioicous.

Var. *β. pungens* Schp. *More slender*, softer, elongated. Branches slender, *strongly arcuate, terete with the leaves all erect and convolute.*

Var. *γ. caespitosum* Whitehead MS., Handb. Ed. I. Short, *densely tufted ;* leaves all *narrow, somewhat tapering and pointed, erecto-patent, not convolute* at tips of stems.

HAB. Wet meadows, marshes, etc., very common. The var. *β* rare. The var. *γ*, Monk's Dale, Derbyshire (*Barker, 1888*) ; Lincolnshire. Fr. summer.

A very common and easily-known species, almost always marked by its cuspidate stems and branches, or in any case by the leaves, which resemble those of none of our other species in structure but *H. Schreberi* and *Cylindrothecium concinnum*, both of which differ in habit, especially the former; both, too, having very different, not or less decurrent angular cells.

H. cuspidatum is often submerged, and then frequently becomes robust and elegantly plumose, with regularly pinnate branches and narrow, strongly divergent leaves ; resembling *H. aduncum* Group *pseudofluitans*.

The var. *caespitosum* described above seems sufficiently marked, even in so variable a plant, to deserve a varietal name. The dense habit and the leaves, uniformly erecto-patent, neither squarrose below nor convolute above, all narrow and pointed, give the plant a very distinct appearance.

41. Hypnum Schreberi Willd. (*Hylocomium parietinum* Lindb., Braithw. Br. M. Fl.) (Tab. LXI. A.).

Stems erect, rigid, *bright red*, simple or divided, with rather close, irregularly pinnate branches, frequently crowded near the top of the stem, which is thus somewhat dendroid ; in large deep tufts of a very glossy pale or yellowish green. Branches more or less curved ; *terete, julaceous or obtuse, or more commonly slender and attenuated*. Leaves close, imbricated, more or less erect and sheathing, very glossy, *lightly plicate, especially when dry*, scariose ; about 1 line long, widely oval-oblong or elliptic, very concave, rounded and obtuse at apex with the margins incurved ; contracted and narrower, but angular and not rounded at insertion ; entire or with a few minute crenulations at tip ; branch-leaves much narrower, oblong, more pointed. Nerve *double, very short and faint ;* cells linear, 10–15 times as long as wide, the walls firm, somewhat incrassate and porose ; at apex short, wide ; at base somewhat wider, incrassate, at angles abruptly *sub-quadrate, moderately enlarged, hyaline or more usually orange, slightly granulose, forming a rather clearly defined triangular patch* at each angle, but not distinctly projecting below the line of insertion nor strongly decurrent. Seta deep red ; capsule sub-cylindric, arcuate, not large ; annulus none. Dioicous.

HAB. Woods and heathlands, common. Fruit very rare, autumn.

H. Schreberi may generally be known from its allies, especially too from *Cylindrothecium concinnum*, which it closely resembles, by the bright red

stems which are seen conspicuously through the semi-transparent leaves. In leaf-form and structure it is only like the last species, whic! frequents moister localities, has a much less woody stem, more distinctly cuspidate tips to the branches, and much more striking auricles, projecting below the base of the leaf and distinctly decurrent. In *H. Schreberi* the auricular cells are practically confined to the angular space at the corner of the leaf, which they fill up as a triangular patch, and while clearly defined are not nearly so large, nor so conspicuous and hyaline.

It is a curious fact that *H. Schreberi*, while with us extremely rare in fruit, is always described in continental works on bryology as commonly fruiting. When fertile the capsules are usually produced in considerable abundance.

H. Schreberi has some resemblance to *Brachythecium purum*, which is however a softer, more prostrate plant, with large, single-nerved, apiculate leaves. It has somewhat the appearance of a *Hylocomium*, and is by Lindberg placed in that genus.

115. **HYLOCOMIUM** B. & S.

Plants usually of free and *robust* growth, irregularly branched or more frequently more or less regularly pinnate or bi-tripinnate; the stems *mostly stout and robust*, hardly radiculose, *often with dense paraphyllia*. Leaves usually *large*, *somewhat scariose*, *generally plicate and rugose when dry*, *frequently muriculate with scattered papillae at back* from the ends of the cell walls. Nerve single and often forked, or double, rarely none; never extending high in the acumen; areolation *narrow-linear*, rarely enlarged at angles. Dioicous. Seta smooth. Capsule *rather large and short*, inclined and curved; lid conical, acuminate or shortly rostrate. Peristome *perfect*.

Separated from Hypnum by a somewhat natural concourse of characters, mostly affecting the habit and appearance of the plants, and less easy to describe in terms than to recognise at sight. Most of the British species are among our commonest and most striking pleurocarpous mosses, and the student soon becomes familiarised with them and is able to distinguish them from Hypnum, and from one another, almost at a glance. The papillae when present are developed from the end walls of the cells, not from their faces as in the Leskeaceae.

Deriv.—The derivation given by the authors of the Bry. Eur. is ὑλοκομος (hylokŏmos), an inhabitant of woods.

1 { Stem thickly covered with branched green paraphyllia.....2
  { Stem without paraphyllia.....5

2 { Stem closely bi tripinnate; ls. imbricate, glossy.....*1. splendens*
  { Stem irregularly or distantly pinnate.....3

3 { Stem-leaves oblong-ovate, imbricate, usually one-nerved...*3. pyrenaicum*
  { Stem-leaves triangular, scarcely imbricate, two-nerved.....4

4 { Stem-ls. decurrent at base, coarsely serrate; lid conic.....*2. umbratum*
Stem-ls. with rounded base, more finely serrate; lid beaked
4. brevirostre

5 { Ls. transversely rugose.....*8. rugosum*
Ls. not transversely rugose.....6

6 { Stem-ls. squarrose-recurved, not plicate.....*6. squarrosum*
Stem-ls. strongly plicate, robust.....7

7 { Erect; stem-ls. spreading in all directions.....*7. triquetrum*
More or less procumbent, ls. somewhat falcato-secund.....*5. loreum*

1. Hylocomium splendens B. & S. (*Hypnum splendens* Hedw.; *Hylocomium proliferum* Lindb., Braithw. Br. M. Fl.) (Tab. LXI. B.).

Stems long, more or less procumbent and trailing, bright reddish, at least in the younger parts, *rigid, robust, clothed with green, subulate, branched paraphyllia;* 4–8 inches long or more, forming large loose mats of a *glossy, yellowish brown or olive green colour;* stems more or less frequently divided, with *very regular bipinnate, complanate, close branching*, occasionally tripinnate, very rarely pinnate only; branches and branchlets *slender*, attenuated, often a little curved at points. Stem-leaves often crowded, nearly erect when dry, *widely ovate or ovate-oblong* from a broad insertion, more or less abruptly acuminate, the point short, straight and obtuse, or variously elongated, flexuose, transversely undulate, and slender; plicate at base, decurrent, concave, somewhat incurved at margin and channelled at point, $\frac{3}{4}$–$1\frac{1}{4}$ lines long, *with more or less numerous, scattered, acute, spinulose papillae at back, especially above;* margin slightly recurved at base, more or less strongly denticulate above, with fine, often spreading teeth; nerve *double*, reaching to one-fourth or one-third the length of the leaf; cells linear, flexuose, 8–10 times as long as wide, *almost uniform to base;* the basal orange, a little larger and incrassate, but *not wide, nor distinct at angles*. Branch-leaves much smaller, more or less imbricated, concave, elliptical-oblong, not plicate, obtusely pointed or slightly acute. Perichaetial bracts long, the inner erect, sheathing. Seta about 1 inch long. Capsule orange-brown, ovate-oblong; lid *rostrate*.

HAB. Heaths, mountain woods, etc., common. Fruiting less commonly, in spring.

The regularly and closely bi-tripinnate branching is the most obvious character of this species, which otherwise has some similarity to *Hypnum Schreberi*, but is quite different in structural points. The mode of growth is somewhat unusual; at various points of the stem, and sometimes at its apex, arise strong, bright green erect shoots, usually curved at the tip, with crowded, julaceous leaves and close, short, simple branches at the summit, being usually unbranched below; these shoots develope into the slender, bi-pinnate fronds, duller in colour, and gradually becoming more prostrate, characteristic of the older part of the plant; when these innovations arise laterally, the stem

becomes divided, when on the other hand they form a prolongation of the stem, the latter becomes interruptedly bi-pinnate. These more or less erect, bright green shoots, are often very characteristic and distinct. Slender forms sometimes occur among other mosses with more erect, simply pinnate stems, and these become more difficult to distinguish in the field from *Hypnum Schreberi* and from *Hylocomium umbratum*. The acuminate stem-leaves and the numerous paraphyllia, quite visible with the lens, will distinguish it from the first; while in *Hyl. umbratum* the branching is more irregularly pinnate, the branches longer, less rigid, and almost always attenuated and somewhat flagelliform at apex, hardly ever at all distinctly complanate, the stem-leaves shorter and wider and more distinctly striate, and all the leaves more triangular, more crisped when dry and less scariose.

The distant, spinulose papillae on the back of the leaves are often very few, but frequently very numerous and distinct; on the branch-leaves they are usually reduced to indistinct notches.

In dry exposed spots the plants become more slender, the branches short, with few branchlets, sometimes indeed simply pinnate (var. *gracilius* Boul.). All degrees of gradation however connect this with the more typical forms.

2. **Hylocomium umbratum** B. & S. (*Hypnum umbratum* Ehrh.) (Tab. LXI. C.).

Slender, rigid, *more erect than H. splendens, more irregularly* and *less complanately* branched, pinnate or bipinnate; branches unequal, *slender*, more or less attenuated and often somewhat flagelliform, frequently drooping, sometimes somewhat interruptedly crowded; stems reddish, clothed with *numerous paraphyllia;* forming loose, deep tufts, 3–8 inches high, of a *bright or yellowish green, not very glossy*. Stem-leaves not densely crowded, sometimes distant, *rather spreading*, about 1 line long, *widely, almost equilaterally triangular*, more or less longly acuminate, or only very acutely pointed, decurrent, *strongly plicate*, somewhat undulate at margin with *very strong*, unequal, often spreading and recurved teeth all round; nerve double, reaching about half-way; cells as in *H. splendens*, or a little larger and longer, not distinct at angles; *without papillae at the back of the leaf*. Branch-leaves smaller, triangular-ovate or widely ovate. Perichaetial bracts squarrose at the points. Capsule rather short, ovate; lid *shortly apiculate*. Dioicous.

Hab. Sub-alpine woods and among rocks on mountains. Rare. North of England; Scotland; North Wales; Ireland. Fr. very rare, spring.

The very numerous paraphyllia combined with the slender habit distinguish this species from all but *H. splendens;* the branching is never distinctly complanate, nor so regularly bipinnate as in that; and the leaves are always more distinctly plicate, somewhat undulate and more altered when dry, and more triangular, even the branch-leaves. *Eurhynchium praelongum* var. *Stokesii* sometimes resembles it in habit, but the squarrose stem-leaves and narrow branch-leaves alone will distinguish that plant without recourse to the microscope.

3. Hylocomium pyrenaicum Lindb. (*Hypnum pyrenaicum* Spruce; *Hyl. Oakesii* Sull., Schp. Syn. et mult. auct.) (Tab. LXI. D.).

More robust than the last. Stems prostrate, with few, ascending, somewhat indistinctly pinnate, *almost simple*, straight or curved branches, *rather tumid*, obtuse or pointed. Tufts low, straggling, *dark olive green or yellowish*, glossy; paler at the tips of the branches. Stems reddish brown, *densely crowded with paraphyllia*. Leaves distant or crowded, large, erect or spreading, concave, *rounded-ovate, or widely ovate-oblong, abruptly contracted to a usually short, wide, acute, somewhat twisted acumen*; narrowed at base, *strongly plicate*, margin *revolute*, strongly toothed, nerve *single*, reaching about half way, rarely forked or double; areolation as in the last two species, a little shorter and wider at apex and base; not papillose at back. Fruit very rare, not found in Britain.

HAB. Mountain rocks at high elevations, very rare; Ben Lawers and one or two other Scotch mountains.

Very distinct from the allied species, in the habit, the more ovate, less triangular, sometimes hardly pointed and usually at most shortly acuminate leaves, rendering the branches robust and tumid in appearance. Stunted forms of *Antitrichia curtipendula* sometimes approach it in habit, but the stem without paraphyllia, the more gradually tapering leaves, etc., will distinguish that species on careful examination, even in the field. *Hyl. brevirostre* is also somewhat like it, but the leaves are more triangular in outline, more longly acuminate, and the plant much more rigid and more branched. American specimens of this plant which I possess are much more slender, with narrow, attenuated branches and narrower, julaceous leaves, giving the plant a very similar appearance to that of *Eurhynchium cirrosum*.

The name *pyrenaicum*, being published by Spruce with No. 4 Musci Pyrenaici, in 1847, must take precedence of Sullivant's name, published in 1848.

4. Hylocomium brevirostre B. & S. (*Hypnum brevirostre* Ehrh.) (Tab. LXI. E.).

Robust, *rigid*, in large tufts or masses of a rather dull but glossy green, often yellowish. Stems much divided, 3–6 inches long, erect or procumbent and arched, with *irregularly pinnate*, long or short, often curved, and attenuated branches, rooting occasionally at the tips, not complanate, *usually crowded*, giving a bushy habit to the plant. Stems reddish, with *smaller and less conspicuous paraphyllia than in the last*. Stem-leaves crowded, patent, not or hardly secund, usually squarrose, large, about 1 line long, *widely cordate-triangular or cordate-ovate, suddenly narrowed at the summit to a moderately long, somewhat channelled, tapering acumen*, at base semi-amplexicaul, *with very large, rounded, sometimes decurrent auricles; plicate*, especially when dry; more finely and regularly denticulate than in the last; nerve *double*, reaching nearly to one-third of the leaf or less, rarely higher.

Median cells as in the previous species, towards base a little laxer, with the walls strongly porose and sinuose. Branch-leaves narrower, less squarrose, strongly striated when dry. Capsule widely ovate-oblong, turgid, lightly striate when dry, lid acuminate, not rostrate.

HAB. Sub-alpine and mountain woods, common ; rare in the lowlands. Fr. spring, rare.

More robust than the preceding species of the genus, and somewhat intermediate in habit between them and the following ones, from all of which it is distinguished by the presence of paraphyllia, which, though rather inconspicuous, are usually numerous. From *H. loreum* and *H. triquetrum* it is known in the field by the more abruptly and shortly pointed branch-leaves, from *H. squarrosum* by the leaves much less squarrose. The var. *calvescens* of that species however resembles it very closely. In its habit and striate leaves it resembles *Eurhynchium striatum*, but the leaves are more finely, and the stem-leaves especially, more abruptly acuminate. The same characters will distinguish it, even more strongly, from robust forms of *Brachythecium rutabulum*.

5. Hylocomium loreum B. & S. (*Hypnum loreum* L.) (Tab. LXI. F.).

Robust, stems 4-10 inches long, flexuose, procumbent, slightly divided, *more or less regularly often interruptedly pinnate*, without paraphyllia ; *the branches equally robust, arcuate, attenuated*, less commonly straight, often rooting at the tips, more or less complanate, but not conspicuously so. Tufts large, soft, pale, often greyish green or yellowish, glossy. Leaves densely imbricated, *usually more or less falcato-secund and homomallous, rigid*, large, 1½ 2 lines long, from an ovate or broadly oblong base *gradually tapering to a long, fine, linear-lanceolate, channelled, strongly recurved acumen, strongly and regularly plicate*, finely and indistinctly denticulate all round, almost nerveless or with two very short, faint striae or nerves ; areolation almost as in *H. brevirostre*, smooth at back. Branch-leaves almost similar, rather narrower. Perichaetial bracts long, sheathing, with slender, squarrose points. Seta 1-1½ inches long, stout. Capsule short and thick, ovate-oblong, *lightly striate when dry and empty ;* lid more or less longly acuminate.

HAB. On the ground and rocks in woods, principally sub-alpine ; frequent. Fr. spring, not uncommon.

A very distinct species, somewhat intermediate in appearance between *H. triquetrum* and *H. squarrosum*, with the leaves arcuate rather than squarrose and by this alone easily distinguished ; it is also much more robust than the latter with strongly plicate, more rigid leaves, although the stems are moderately soft and flexuose. In the absence of paraphyllia and the gradually tapering leaves, almost equal on stem and branches, it is quite distinct from the preceding species. Like *H. splendens* it fruits freely and not uncommonly in damp sub-alpine woods.

6. Hylocomium squarrosum B. & S. (*Hypnum squarrosum* L.) (Tab. LXI. G.).

Stems more or less erect, without paraphyllia, usually prostrate at base and then ascending or erect, tall, 4-6 inches, *more slender and flexuose than in H. loreum and H. triquetrum*, pinnate with short branches which are mostly slender, *decurved, attenuated and sub-flagelliform;* forming dense *pale green or yellowish green soft tufts*, whitish below, glossy. Leaves more or less crowded, 1½ lines long, *from an erect, sheathing cordate-ovate base suddenly recurved-squarrose, with a long, gradually tapering, linear-lanceolate, channelled acumen*, imbricated all round the stem, *not secund;* at apex of stems stellately spreading so as to render the stems very obtuse; *not plicate*, or very lightly so at base only; finely denticulate, especially above; nerve short and faint, double, hardly reaching half way; cells rather larger than in the preceding species of the genus, 8-10 times as long as wide, *smooth at back; angular wider, short, rectangular-hexagonal*, opaque or pellucid, often orange, very numerous, *forming large, distinct but not well-defined auricular patches* extending considerably towards the nerve. Branch-leaves smaller, narrower, less squarrose. Seta slender, 1-1½ inches long, capsule short, turgidly oval, gibbous at back; lid acutely conical.

Var. β. *calvescens* Hobkirk (*Hypnum calvescens* Wils.; *Hyl. calvescens* Lindb.; *Hyl. squarrosum* var. *subpinnatum* Schp., Syn.). Stems bright red. Stem-leaves rather distant, usually *wider at the base, cordate-triangular* rather than cordate-ovate; generally but not always *somewhat distinctly plicate* below when dry, *more shortly acuminate*, more strongly denticulate above, the auricles more clearly defined and pellucid; stems *more closely pinnate*, with robust or more slender, attenuated, flexuose branches; branch-leaves very distinct from the stem-leaves, *widely ovate, very shortly acuminate or only acute, not squarrose, half twisted when dry.*

HAB. Grassy banks, hedgerows, etc., abundant. The var. β very rare. Fruit rare, winter and spring.

A very common species, known at once by its pale colour, tall, somewhat soft and slender stems, and strongly recurved-squarrose leaves; the acumen of which spreads in different ways, sometimes about horizontally but often so strongly reflexed as to be parallel with the stems and to touch the leaf immediately below it. The more strongly reflexed rather than recurved leaves, not falcato-secund, not or hardly striate, and the much more slender and softer habit of the plant abundantly separate it from *H. loreum;* while *H. triquetrum* is still more distinct in its straight, not reflexed nor recurved leaves, scabrous at back, and by its much more robust, stiff habit.

An almost prostrate, often less glossy form is not unfrequently found by roadsides and on the beds of dried up pools.

The var. *calvescens* is a very curious and distinct form, when typical; it bears a great resemblance in its strongly marked forms to *Hyl. brevirostre*, but the smooth stems without paraphyllia at once separate it. The branch-

leaves in the type are somewhat dimorphous, all on some of the more robust branches, and those at the base of the slender ones being almost similar to those of the stem, with long, gradually tapering, spreading or squarrose points, though generally less strongly recurved; the leaves on the upper part of the slender, flagelliform branches are quite different, smaller, sub-erect, not spreading, with short, abrupt points, very closely resembling those of *H. brevirostre*. In the var. *calvescens* all the branch-leaves, even on the more robust branches, are of this character, and it is this which gives the variety its peculiar appearance. It is more rigid and robust than the type. It appears to me clear that it can only be held a variety of the present plant, for in specimens sent me by Mr. Whitehead from Dolgelly, the stem-leaves have exactly the squarrose-recurved direction of *H. squarrosum*, though wider at base, and more shortly acuminate; the characters attributed by Lindberg to the fruit, viz., a short striated capsule, and short seta, are equally applicable to forms of *H. squarrosum*. The leaves vary in form and direction on the same stem, and it is altogether a somewhat ill-defined, but nevertheless very remarkable variety.

7. Hylocomium triquetrum B. & S. (*Hypnum triquetrum* L.; *H. corrugatulum* Stirt. in Ann. Scot. Nat. Hist. xvi, 180) (Tab. LXI. H.).

Very robust, *rigid*, 4–8 inches high, deep bright green or yellowish, in large mats. Stems more or less ascending at base or altogether erect, *very stout and rigid*, simple or slightly divided, branched unequally and irregularly, or with pinnate but not complanate branches which are *close and give the plant a bushy appearance*. Leaves *very large*, 2 or nearly 3 lines long, *rigidly divergent or horizontally spreading from the base both wet and dry*, *rarely secund*, straight, *very stiff and scariose*, glossy, *widely deltoid-triangular*, at base widely rounded-auriculate from a rather narrow decurrent insertion, then *gradually tapering upwards to a wider or narrower acute point*, *hardly acuminate*, *plicate*, especially when dry, closely denticulate all round, with two parallel slender nerves reaching about ¾ the length of the leaf; upper areolation resembling that of *H. squarrosum*, at basal angles *wide*, *pellucid*, hexagonal-oblong, *but not so distinct as in the last species* nor forming such marked auricles; back of the leaf in the upper half *scabrous with rather close*, *stout*, *spinulose papillae*. Seta 1 1½ inches long; capsule rather large, turgidly oblong, gibbous at back, almost smooth or widely striate when dry and empty; lid acutely conical.

HAB. On the ground in woods, hedges, etc. Common. Fruit not common, winter.

This is one of our most robust and finest species, especially when fully developed and luxuriant; like the last species it is a more lowland plant than the preceding species of the genus. It is abundantly distinct in its robust, rigid stems, tumid, and bristling with the squarrose, straight, not recurved, plicate, deltoid leaves. The branches are very unequal, sometimes short, obtuse, with leaves similar to those of the stems, at others longer, slender and attenuated, at the apex at least, with the leaves very much smaller and narrower.

Owing to the very rigid, yet elastic texture of the plant, this moss is largely used for packing china and other brittle articles.

8. Hylocomium rugosum De Not. (*Hypnum rugosum* Ehrh., Schp. Syn. et plur. auct.) (Tab. LXI. I.).

Stems more or less procumbent or ascending, not radiculose, long, flexuose, *simple or with few, short, more or less regularly pinnate branches;* 2-4 inches long. Stems and branches *very tumid and robust* with the large, *closely imbricated*, concave leaves; forming large, glossy, *yellowish green or golden brown* tufts. Leaves 1½–2 lines long, widely oblong-lanceolate or ovate-acuminate, rather rapidly tapering to a moderately long, acute, flexuose acumen, *regularly falcato-secund* but not circinate nor very strongly curved, except at the tips of the branches, which are slightly hooked; somewhat membranaceous in texture, longitudinally plicate and *strongly transversely undulate-rugose* both when wet and when dry, *narrowly revolute at margin for the greater part of its length*, more or less strongly denticulate, at back *studded with more or less numerous but not crowded, stout, acute, spinulose papillae*, pointing forward; nerve *single*, often slightly forked, very slender in the upper part, reaching half or two-thirds the length of the leaf. Cells short, 5-8 times as long as wide, linear, obtuse, flexuose, incrassate, almost uniform to mid-base; angular *very numerous, small*, irregularly quadrate-rounded, sub-equal, very distinct, but opaque and granulose, forming *distinct angular bands reaching high at margin but not wide*. Dioicous.

HAB. Among grass, etc., on rocks, preferring those which are calcareous; principally on mountains. Not common. Fruit not found in Britain.

A very distinct and very variable plant, somewhat resembling *Hypnum lycopodioides* in habit, but of quite different structure, and found in quite distinct habitats, with the undulations not large and irregular as in that, where they are merely the result of drying, but small, strong, and more regularly transverse, almost as marked in the moist state as when dry. The spinulose papillae at back are often very numerous and striking. Schimper places it in the sub-genus Rhytidium of Hypnum, but it appears to be as much at home in the present genus as in Hypnum, and in some respects, especially in the papillose leaves, more so.

ADDENDA AND CORRIGENDA.

P. 19, line 4 from bottom, for LXI. B, read III. E.

P. 130, line 11 from bottom, for LII. read LXII.

P. 209. Since writing the note on *Barbula botelligera*, I learn from Herr Loeske that Dr. Moenkemeyer has compared his species with our British plant, and is satisfied of their identity. A further complication, however, is added by the discovery that *Barbula ferruginascens* Stirt. is identical with *B. rubella* var. *ruberrima*, and that name must therefore, if the plant is raised to specific rank, have priority over *B. botelligera* Moenk.

P. 267. The statement as to the occurrence of *U. phyllantha* on Chimborazo, quoted from Wilson, is found to be an error. The moss in question is not a Ulota, but a species of Orthotrichum.

P. 446, line 1. For var. β read var. δ.

INDEX.

[Synonyms are printed in ordinary type refer to the page where the species is *described ;* numbers printed in italics refer to the page where a species or variety (if foreign) is *referred to,* or (if British) is *mentioned* outside its own genus. The Roman numerals following the generic names refer to the Plates on which the species of the genus are figured.

The accent placed over the vowel in the names of British genera and species shows the accented syllable. An acute accent (') indicates that the accented vowel is short, a grave accent (`) that it is long.

In the case of certain names derived from proper nouns with a short final syllable, notably Bartrăm, Breutĕl, De Notaris, although the pronunciation should, strictly speaking, be Bartrámia Breutélia, Notarísii, still the form Bartràmia, Breutèlia, Notarìsii appears to be to some extent justified by custom, and by a certain principle of euphony, and has also received considerable support from authority. In these cases however I have indicated the original shortness of the vowel by the accent, while recognising the claim of, and to some extent sharing the preference for the alternative pronunciation. In one instance, however, viz., intermedium (and medium), I have treated the vowel as long, viz., intermèdium, in deference to an established national habit, which has received the sanction of several high botanical (and classical) authorities, although it is in direct violation of the actual Latin quantity (intermĕdium). See also note on p. xxv.]

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grácilis Wils., 261
lappónicus B. & S., 257, *88*, *256*
Mougeòtii B. & S., 258, *206*, *233* *235*, *256*
Nowellii Schp., 261
rupestris Lindb., 259
Sendtneri Vent. & Bott., 260
Stírtoni Schp., 259
teichophilus Stirt., 257
viridíssimus R. Brown, 258, *256*
Zygotrichia cylindrica Tayl., 214

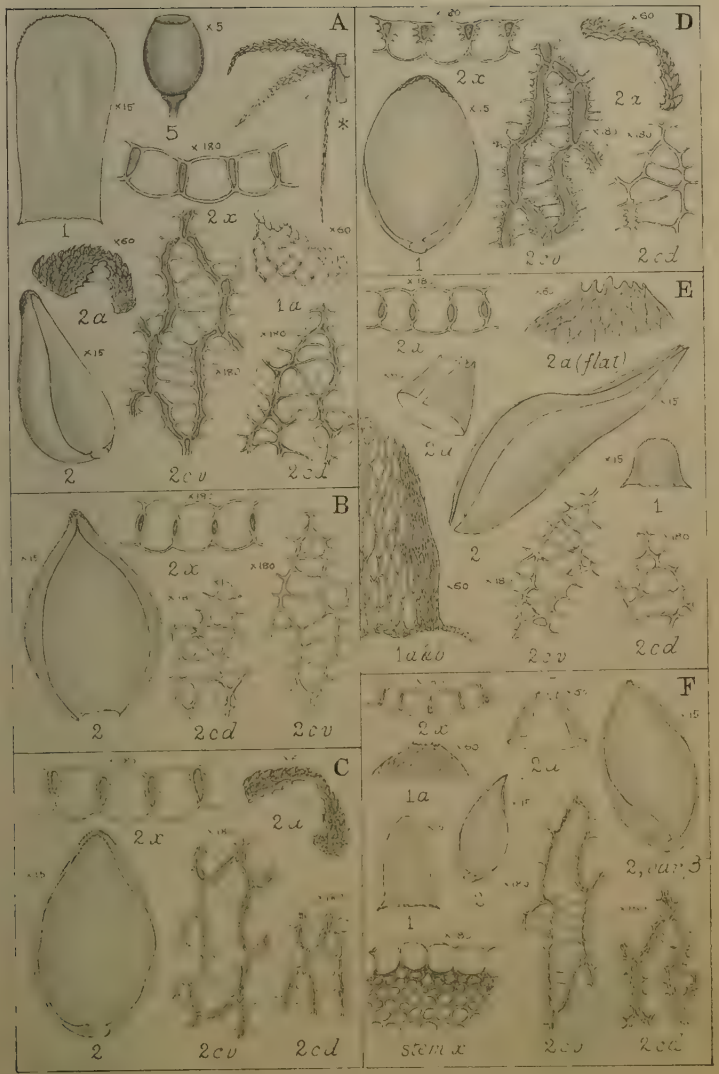
PLATES.

EXPLANATION OF PLATES.

The following signs are used with a uniform signification throughout the Plates :—

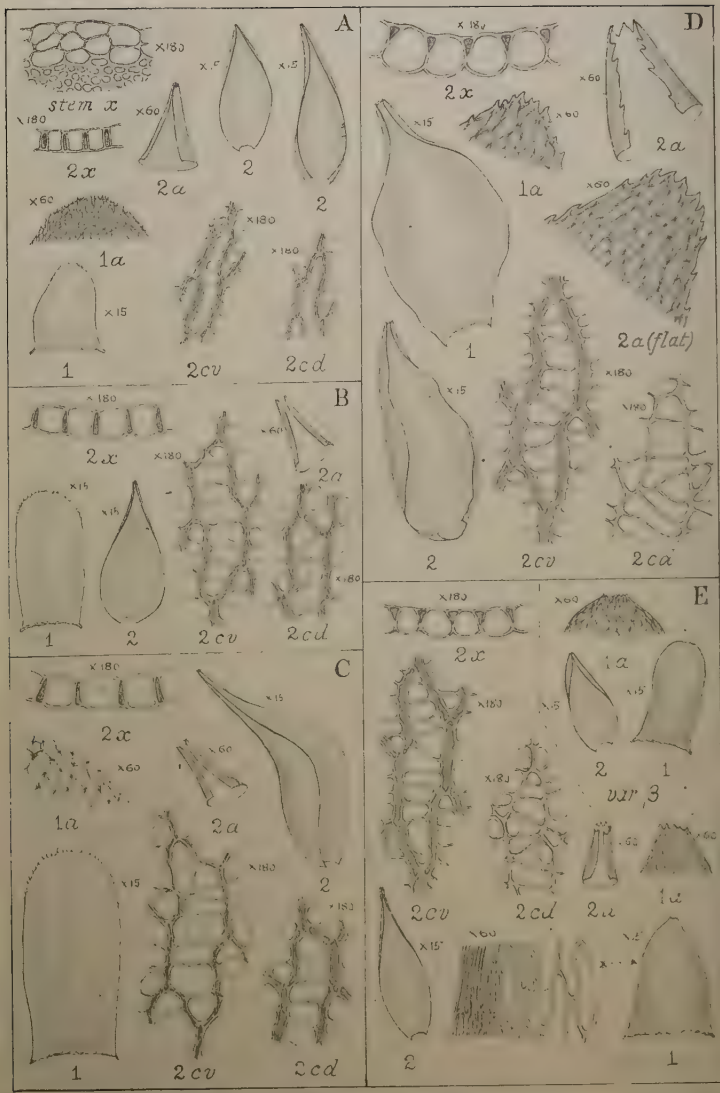
1.	Leaf (or stem-leaf, where these differ).	11.	Paraphyllia.
2.	Branch-leaf.	12.	Stoma of capsule.
3.	Perichaetial leaf.	*	Plant (or portion of do.).
4.	Perigonial leaf.	*a*	Apex.
5.	Capsule.	*b*	Base.
6.	Peristome.	*c*	Cells at one-third from apex of leaf.
7.	Calyptra.	*cv*	Ventral aspect of cells.
8.	Spores.	*cd*	Dorsal aspect of cells.
9.	Inflorescence.	*bc*	Basal cells.
10.	Gemmae.	*x*	Section.

The explanation of the numbered figures on Plates LXII and LXIII will be found opposite to the Plates themselves.

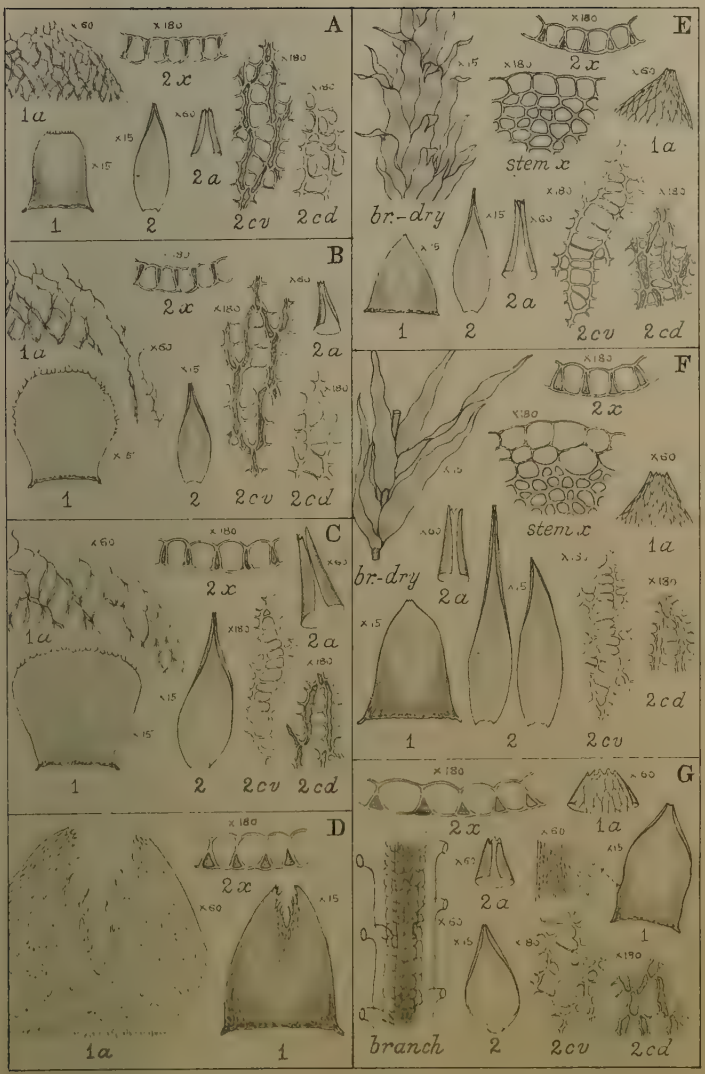


A. Sphagnum cymbifolium **B.** S. medium. **C.** S. papillosum. **D.** S. Austini. **E.** S. rigidum. **F.** S. subsecundum.

TAB. II.

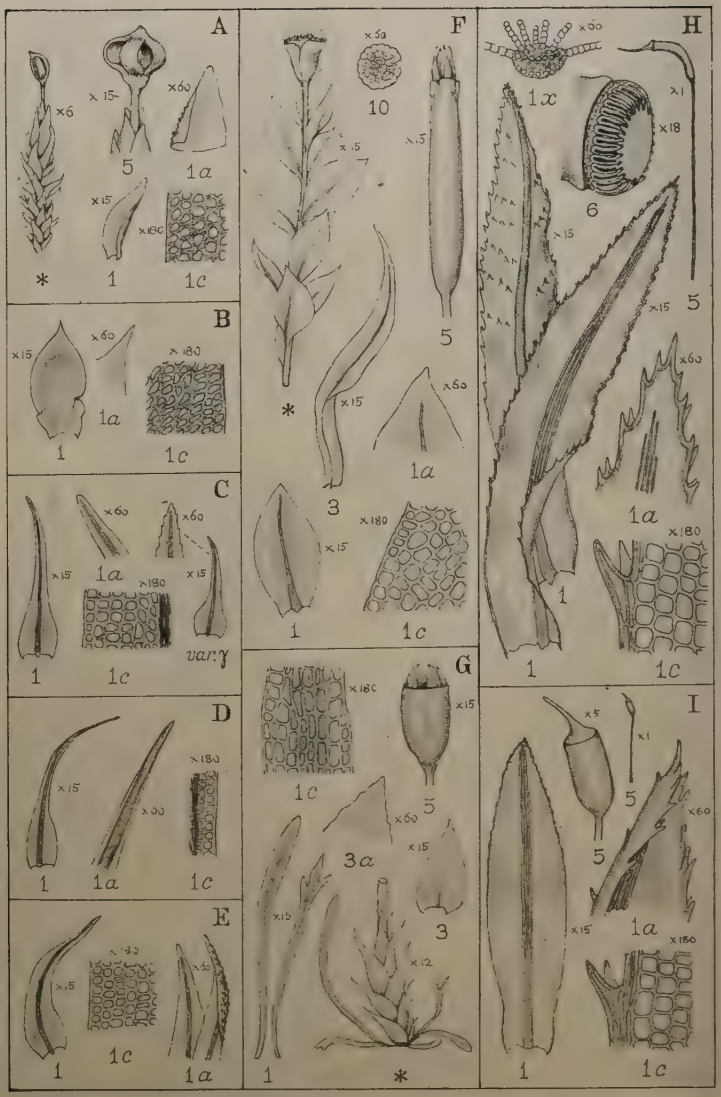


A. Sphagnum laricinum. **B.** S. teres. **C.** S. squarrosum. **D.** S. molle.
E. S. acutifolium with *var.* γ (*not* β) rubellum.

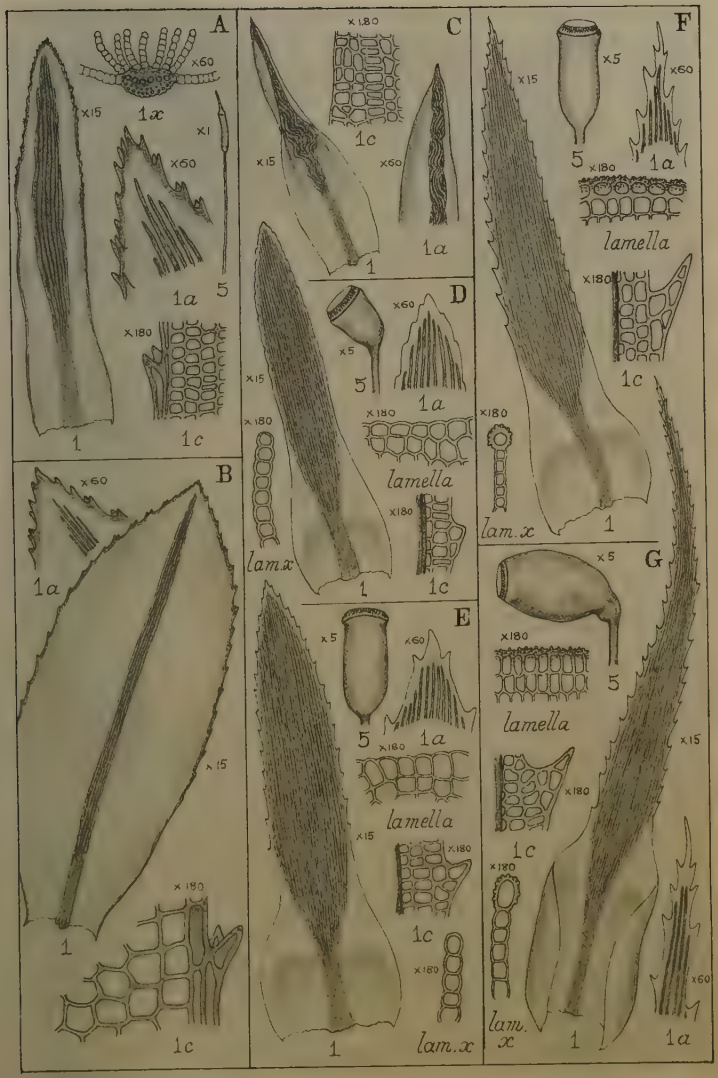


A. Sphagnum Girgensohnii. **B.** S. fimbriatum. **C.** S. Lindbergii. **D.** S. riparium. **E.** S. intermedium. **F.** S. cuspidatum. **G.** S. tenellum.

TAB. IV.

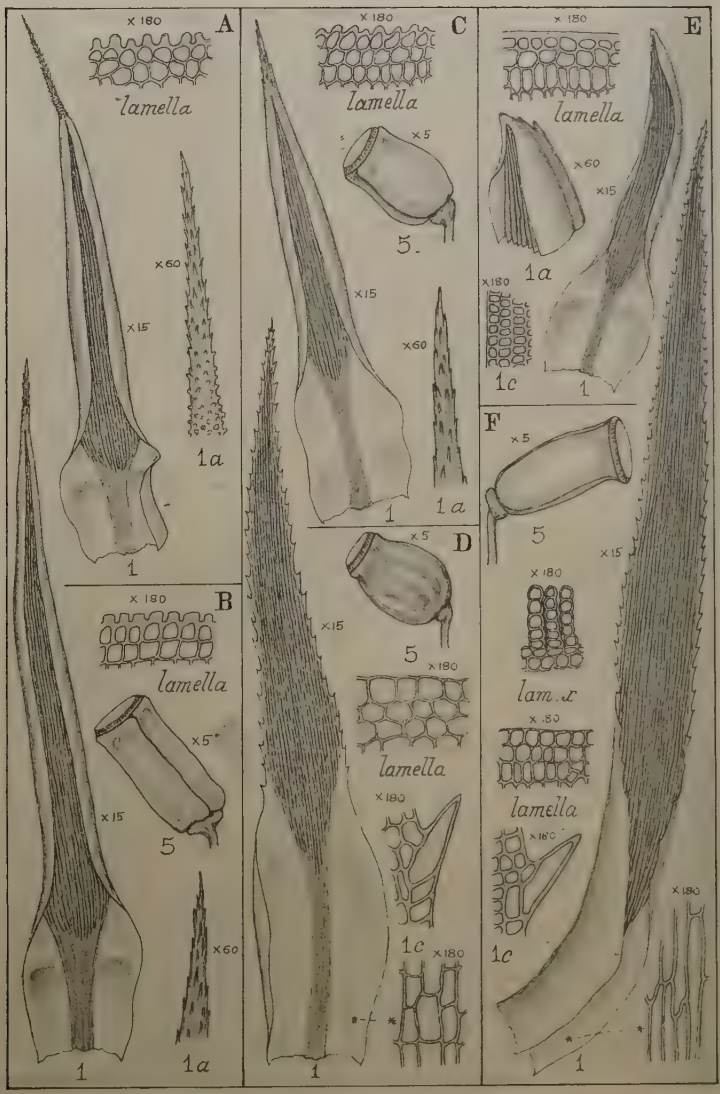


A. Andreaea petrophila. **B.** A. alpina. **C.** A. Rothii. **D.** A. crassinervia. **E.** A. nivalis. **F.** Tetraphis pellucida. **G.** T. Browniana. **H.** Catharinea undulata. **I.** C. tenella.

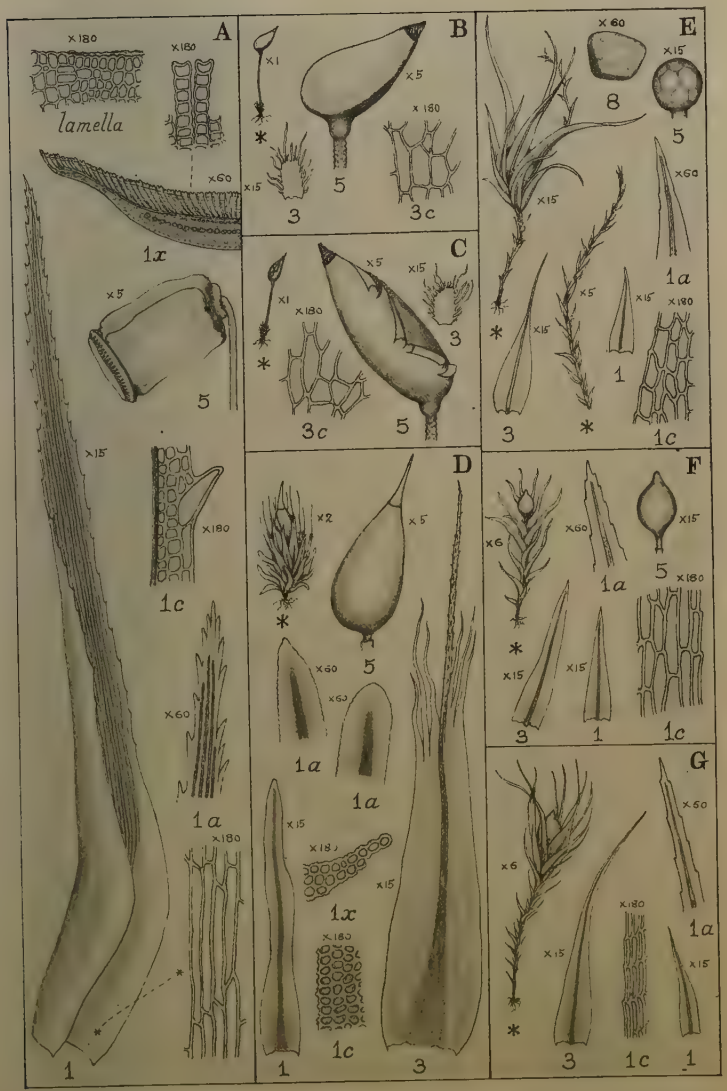


A. Catharinea angustata. **B.** C. crispa. **C.** Oligotrichum hercynicum.
D. Polytrichum nanum. **E.** P. aloides. **F.** P. urnigerum. **G.** P. alpinum.

TAB. VI.

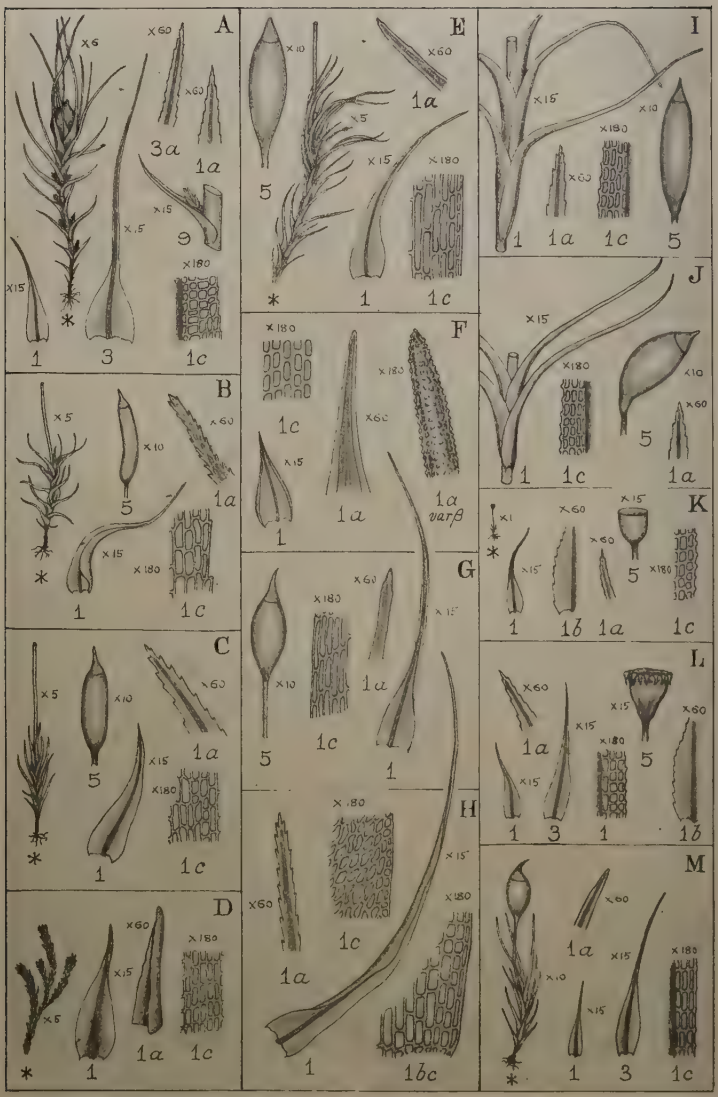


A. Polytrichum piliferum. **B.** P. juniperinum. **C.** P. strictum. **D.** P. gracile. **E.** P. sexangulare. **F.** P. formosum.

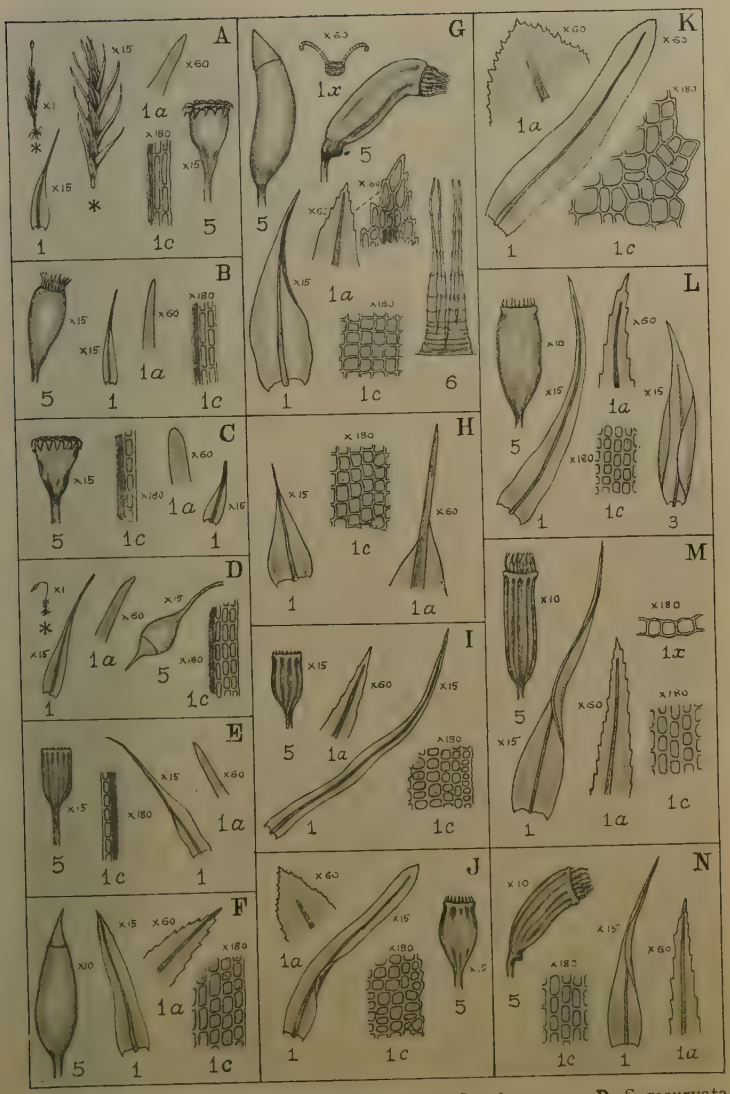


A. Polytrichum commune. **B.** Buxbaumia aphylla. **C.** B. indusiata.
D. Diphyscium foliosum. **E.** Archidium alternifolium. **F.** Pleuridium axillare.
G. P. subulatum.

TAB. VIII.

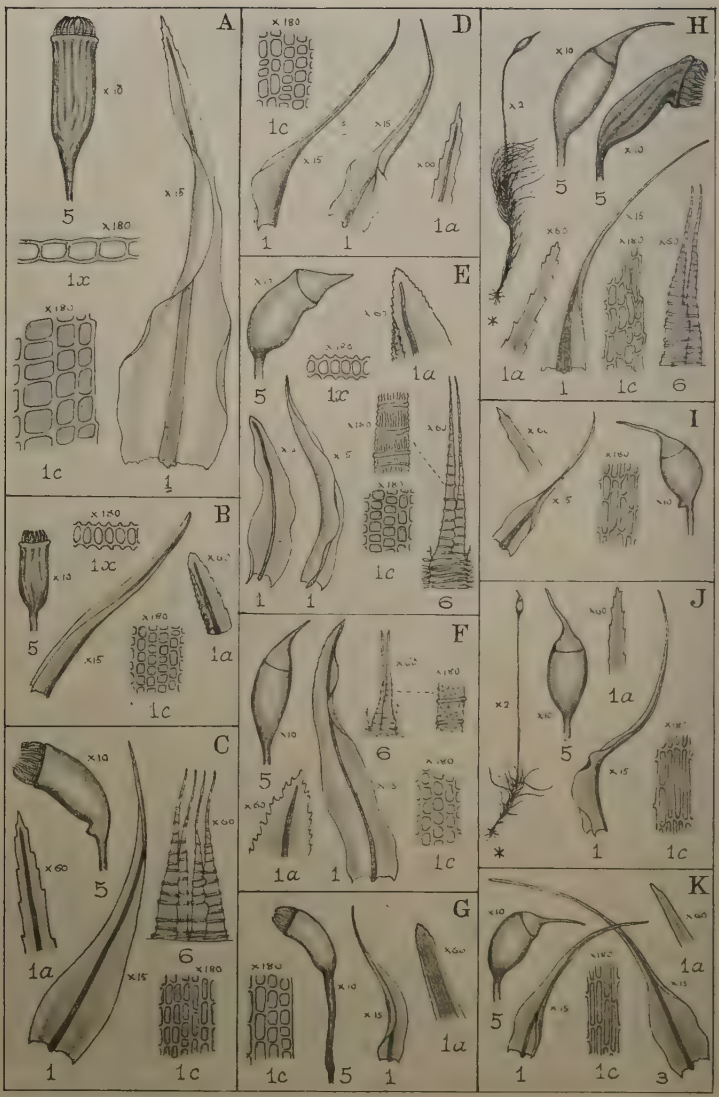


A. Pleuridium alternifolium. **B.** Ditrichum tenuifolium. **C.** D. tortile.
D. D. vaginans. **E.** D. homomallum. **F.** D. zonatum. **G.** D. subulatum.
H. D. flexicaule **I.** Swartzia montana. **J.** Sw. inclinata. **K.** Seligeria Doniana.
L. S. pusilla. **M.** S. acutifolia.

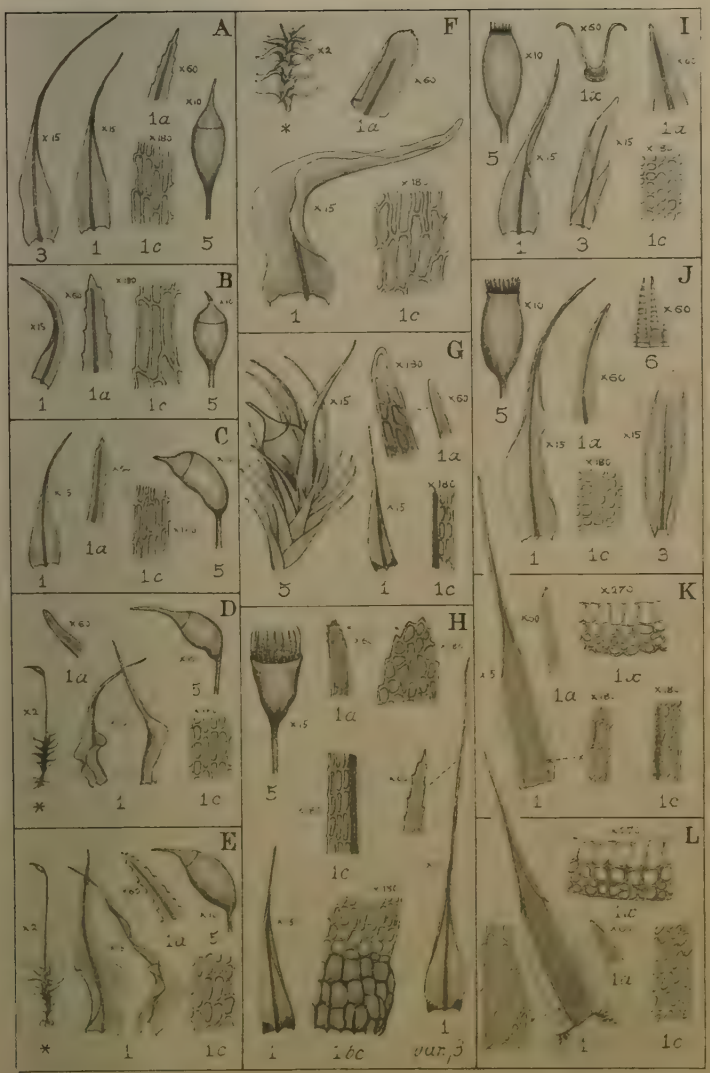


A. Seligeria tristicha. **B.** S. paucifolia. **C.** S. calcarea. **D.** S. recurvata.
E. Brachyodus trichodes. **F.** Saelania caesia. **G.** Ceratodon purpureus.
H. C. conicus. **I.** Rhabdoweisia fugax. **J.** R. denticulata. **K.** R. crenulata.
L. Cynodontium Bruntoni. **M.** C. polycarpum. **N.** C. strumiferum.

TAB. X.

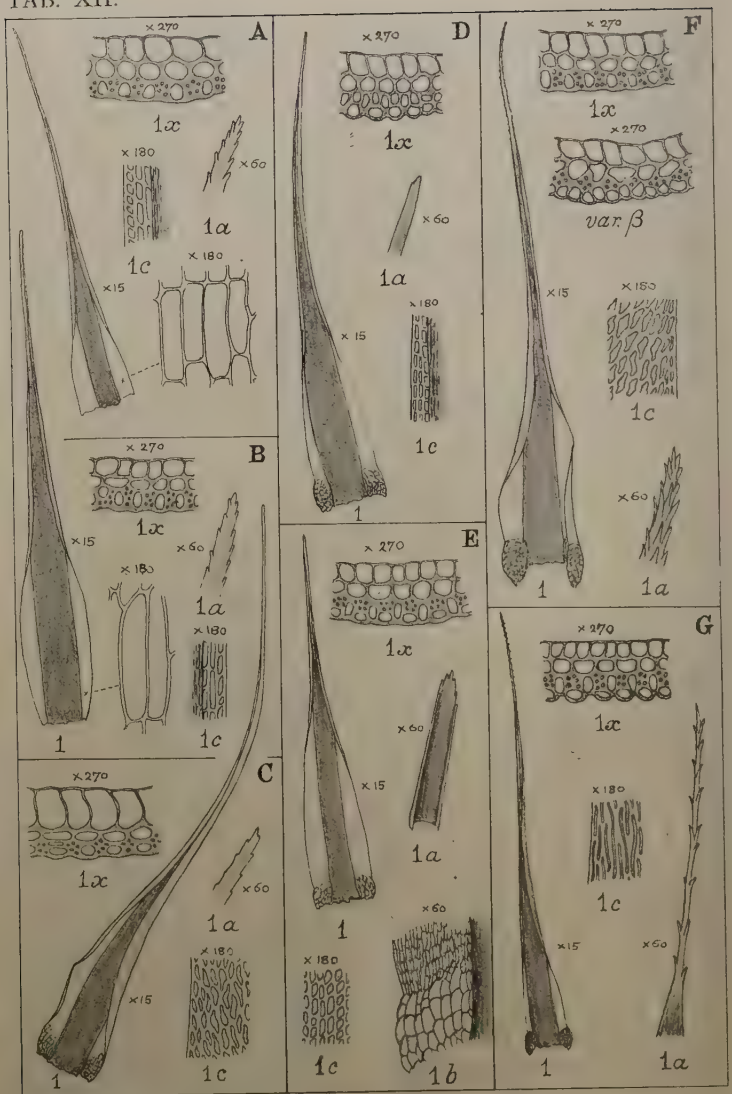


A. Cynodontium Jenneri. **B.** C. gracilescens. **C.** C. virens. **D.** C. Wahlenbergii.
E. Dichodontium pellucidum. **F.** D. flavescens **G.** Trematodon ambiguus.
H. Dicranella heteromalla. **I.** D. cerviculata. **J.** D. crispa. **K.** D. secunda.

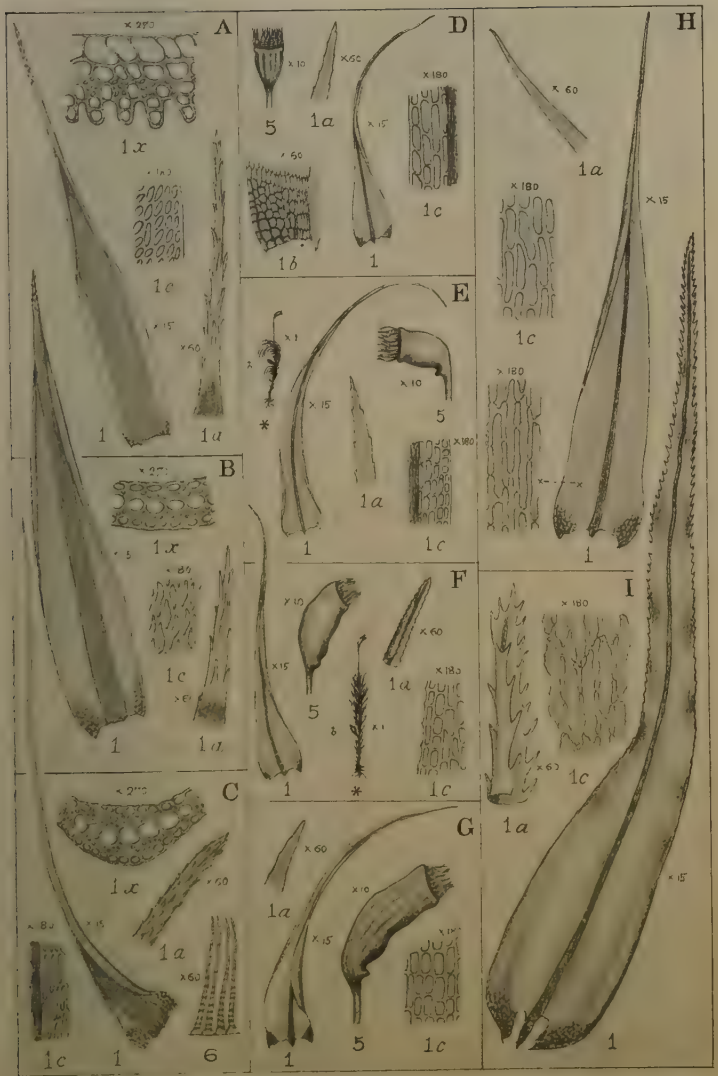


A. Dicranella curvata. **B.** D. rufescens. **C.** D. varia. **D.** D. Grevilleana.
E. D. Schreberi. **F.** D. squarrosa. **G.** Blindia caespiticia. **H.** B. acuta.
I. Dicranoweisia cirrata. **J.** D. crispula. **K.** Campylopus subulatus
L. C. Schimperi.

TAB. XII.

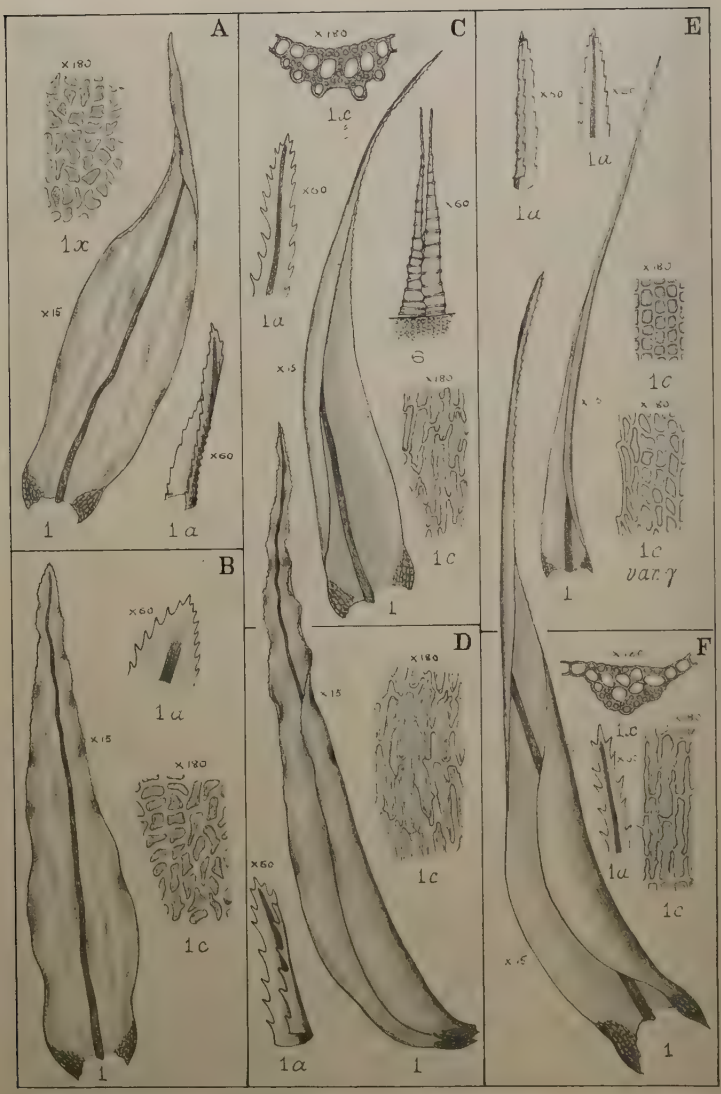


A. Campylopus pyriformis. **B.** C. fragilis. **C.** C. Shawii. **D.** C. Schwarzii. **E.** C. flexuosus. **F.** C. setifolius. **G.** C. atrovirens.

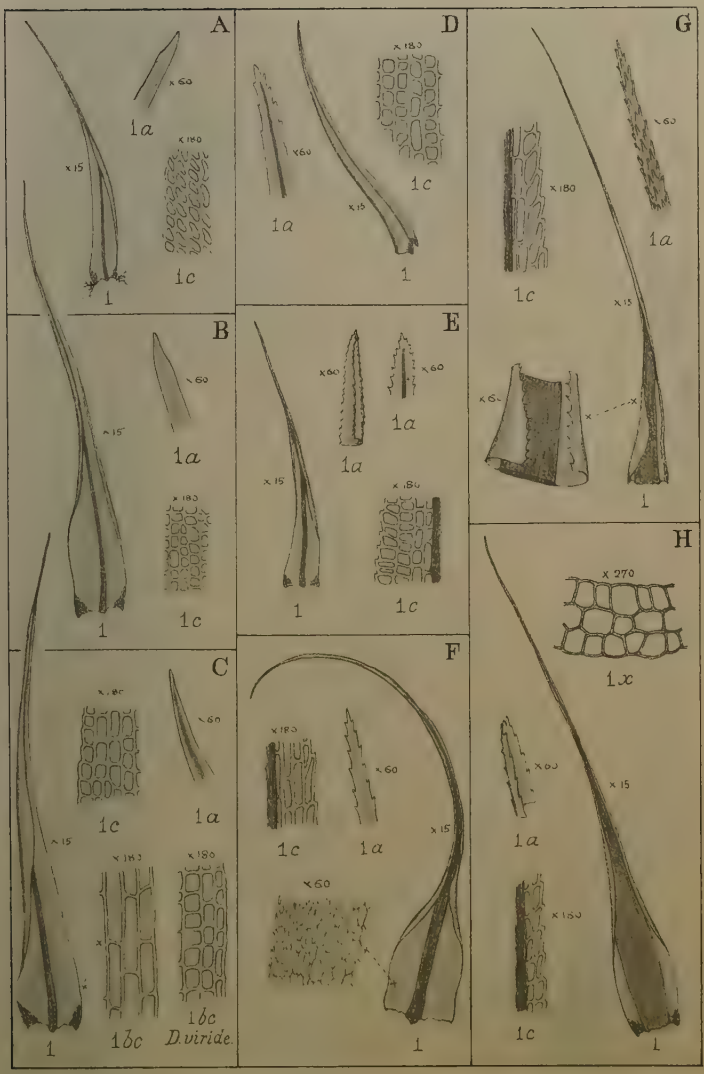


A. Campylopus introflexus. **B.** C. brevipilus. **C.** Dicranodontium longirostre.
D. Dicranum fulvellum. **E.** D. falcatum. **F.** D. schisti. **G.** D. Starkii.
H. D. molle. **I.** D. undulatum.

TAB. XIV.

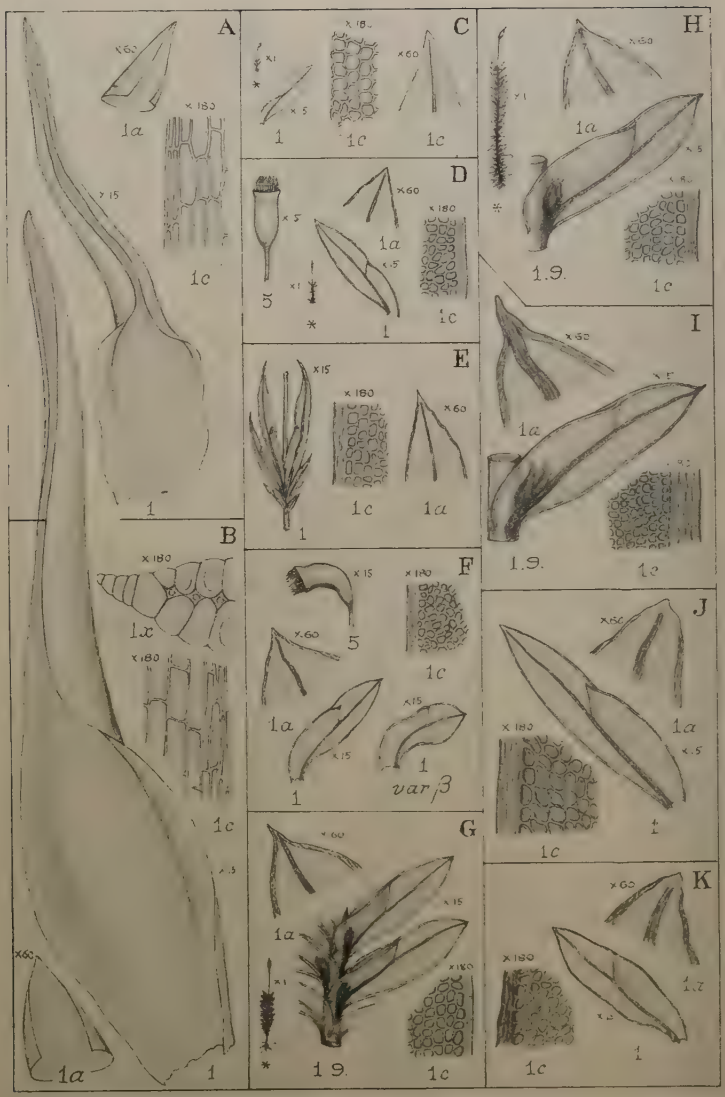


A. Dicranum spurium. **B.** D. Bergeri. **C.** D. scoparium. **D.** D. Bonjeani. **E.** D. fuscescens. **F.** D. maius.

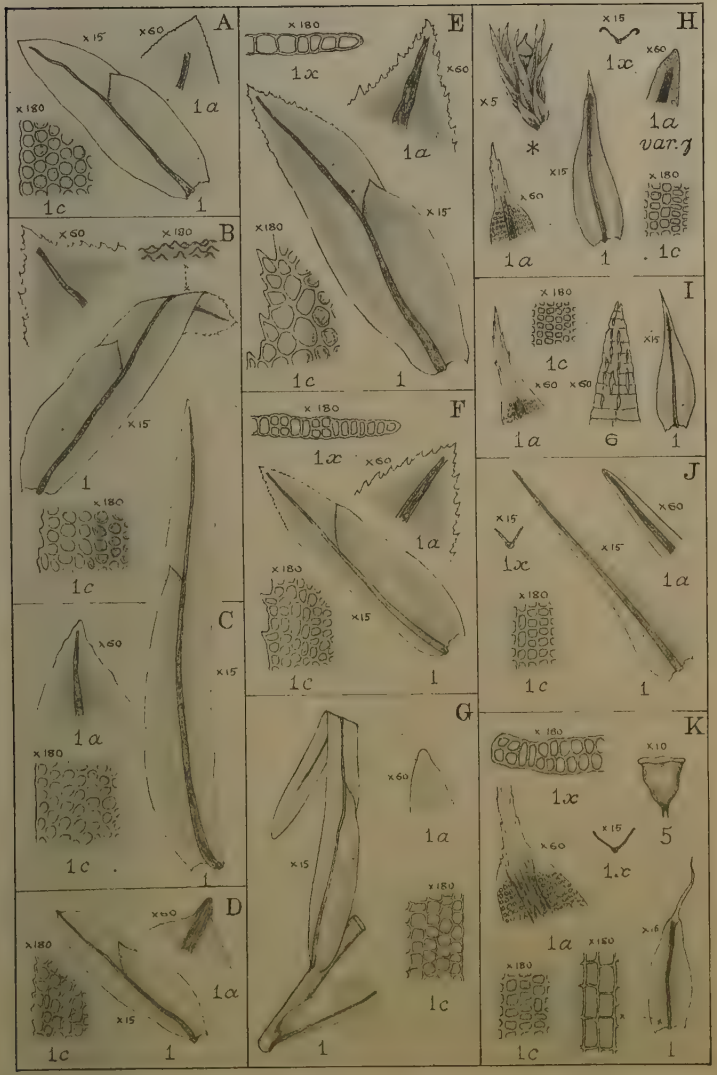


A. Dicranum elongatum. **B.** D. Scottianum. **C.** D. strictum. **D.** D. flagellare. **E.** D. montanum. **F.** D. uncinatum. **G.** D. asperulum. **H.** D. longifolium.

TAB. XVI.



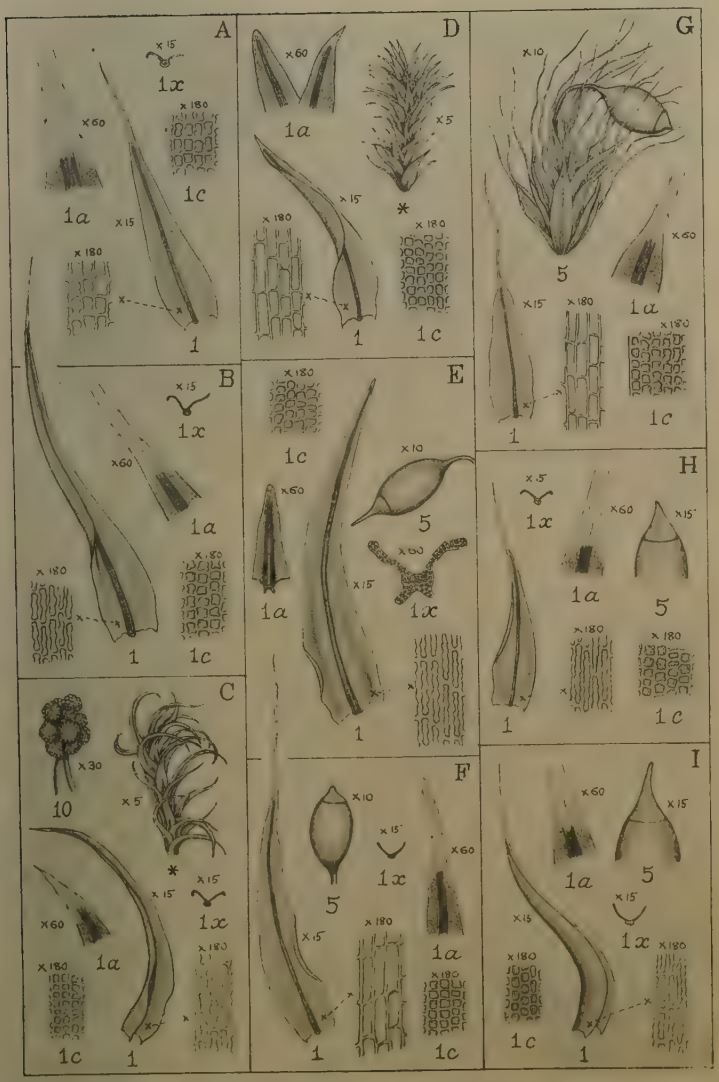
A. Leucobryum albidum. **B.** L. glaucum. **C.** Fissidens exilis **D.** F. viridulus. **E.** F. pusillus **F.** F. incurvus. **G.** F. bryoides. **H.** F. Curnowii. **I.** F. rivularis. **J.** F. crassipes. **K.** F. rufulus.



A. Fissidens osmundioides. **B.** F. serrulatus. **C.** F. polyphyllus.
D. F. taxifolius. **E.** F. adiantoides. **F.** F. decipiens. **G.** Octodiceras Julianum.
H. Grimmia apocarpa. **I.** G. conferta. **J.** G. maritima. **K.** G. anodon.

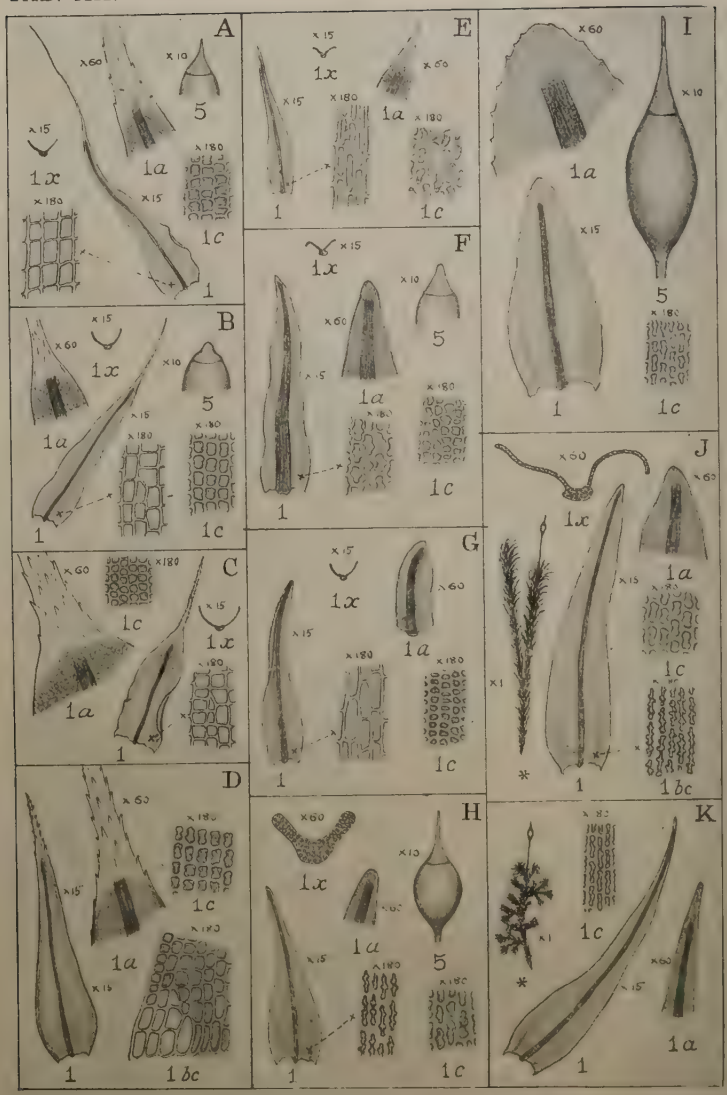
TAB. XVIII.

A. Grimmia crinita. **B.** G. incurva. **C.** G. funalis. **D.** G. torquata.
E. G. pulvinata. **F.** G. orbicularis. **G.** G. trichophylla. **H.** G. Muehlenbeckii.
I. G. Stirtoni. **J.** G. subsquarrosa. **K.** G. decipiens.

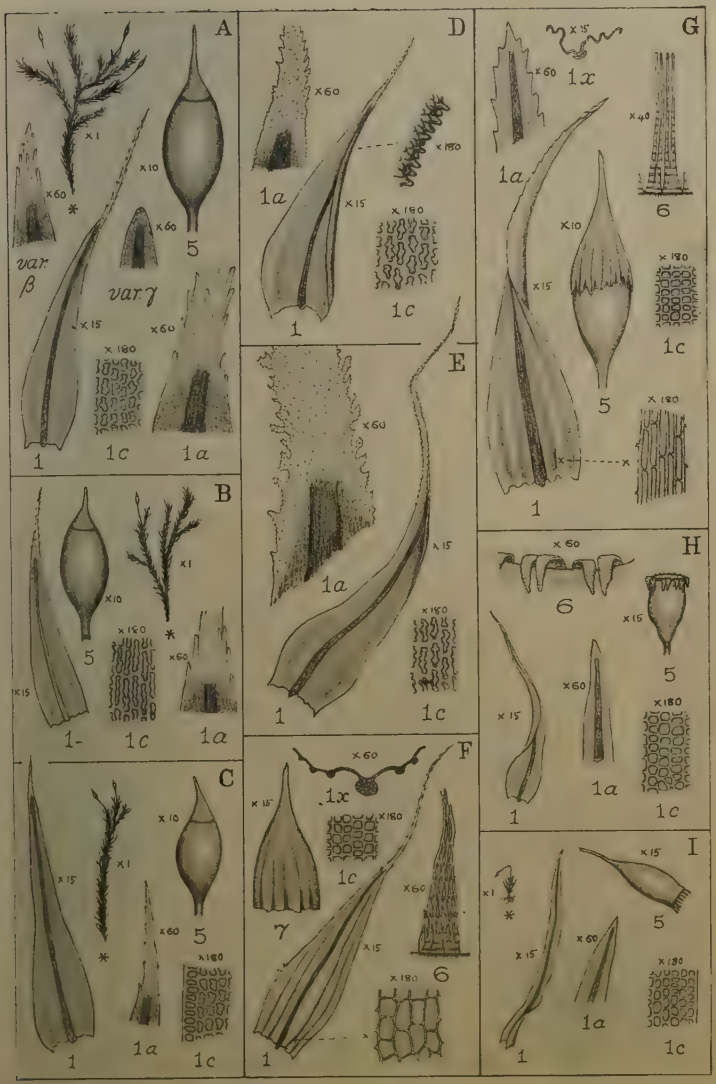


A. Grimmia robusta. **B.** G. elatior. **C.** G. Hartmani. **D.** G. retracta.
E. G. patens. **F.** G. Doniana. **G.** G. arenaria. **H.** G. ovata. **I.** G. commutata.

TAB. XX.

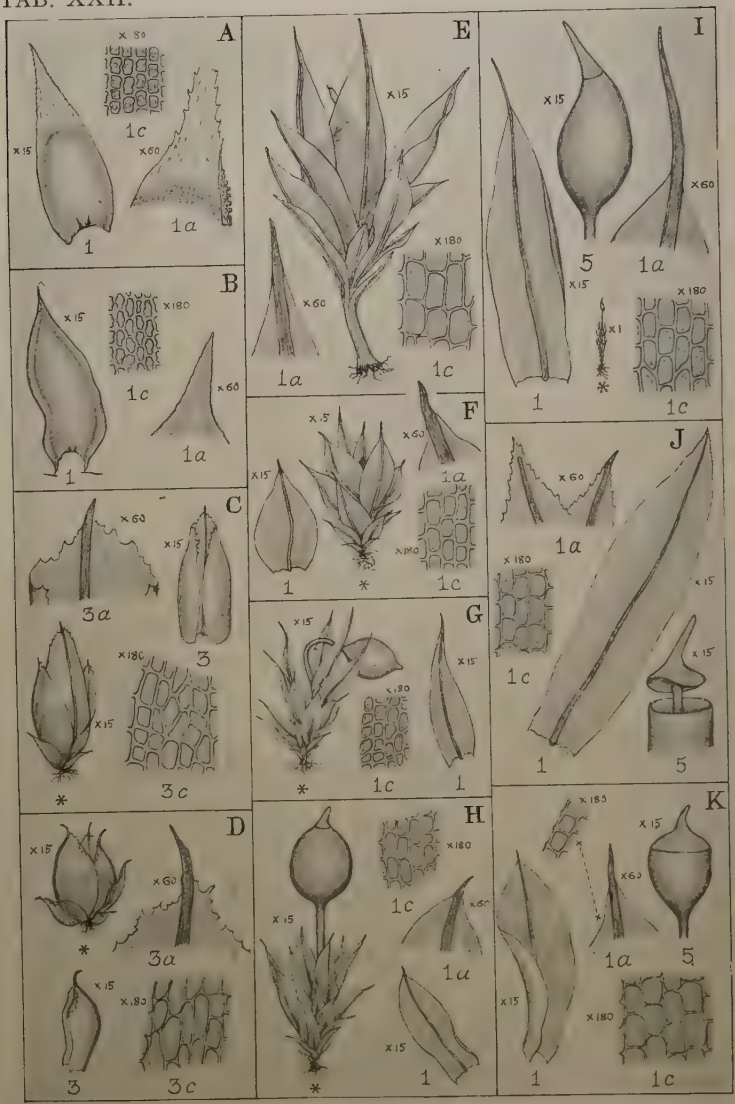


A. Grimmia montana. **B.** G. alpestris. **C.** G. leucophaea. **D.** G. homodictyon. **E.** G. elongata. **F.** G. atrata. **G.** G. unicolor. **H.** Rhacomitrium ellipticum. **I.** R. aciculare. **J.** R. protensum. **K.** R. fasciculare.

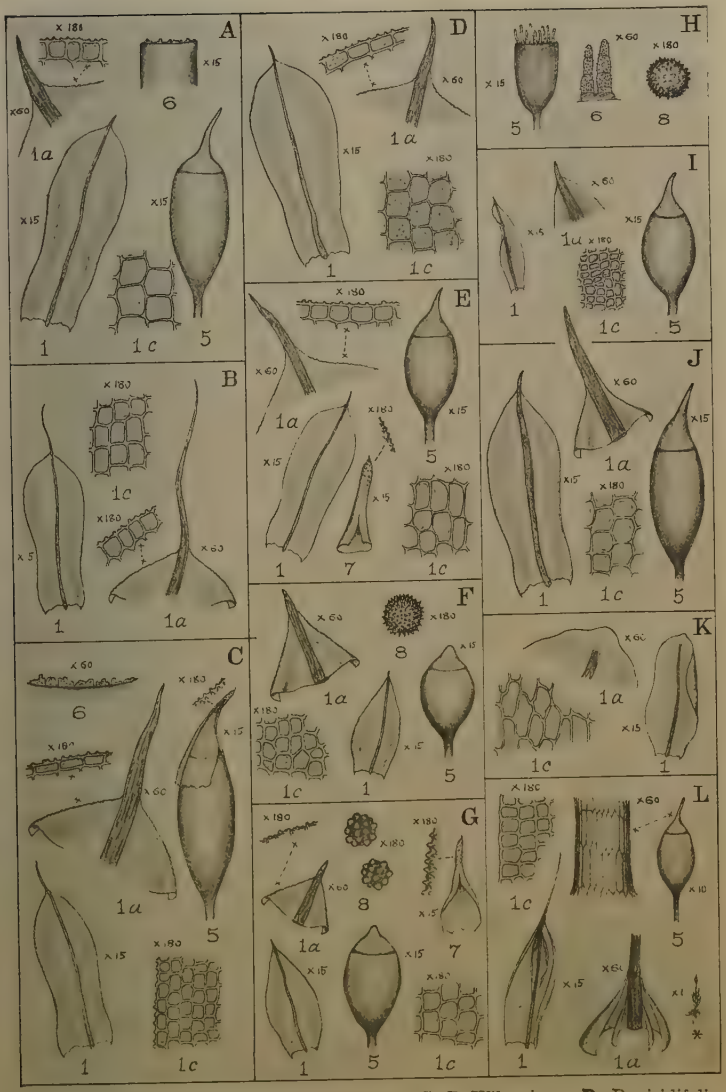


A. Rhacomitrium heterostichum. **B.** R. ramulosum. **C.** R. sudeticum.
D. R. canescens. **E.** R. lanuginosum **F.** Coscinodon cribrosus.
G. Ptychomitrium polyphyllum. **H.** Glyphomitrium Daviesii.
I. Campylostelium saxicola.

TAB. XXII.

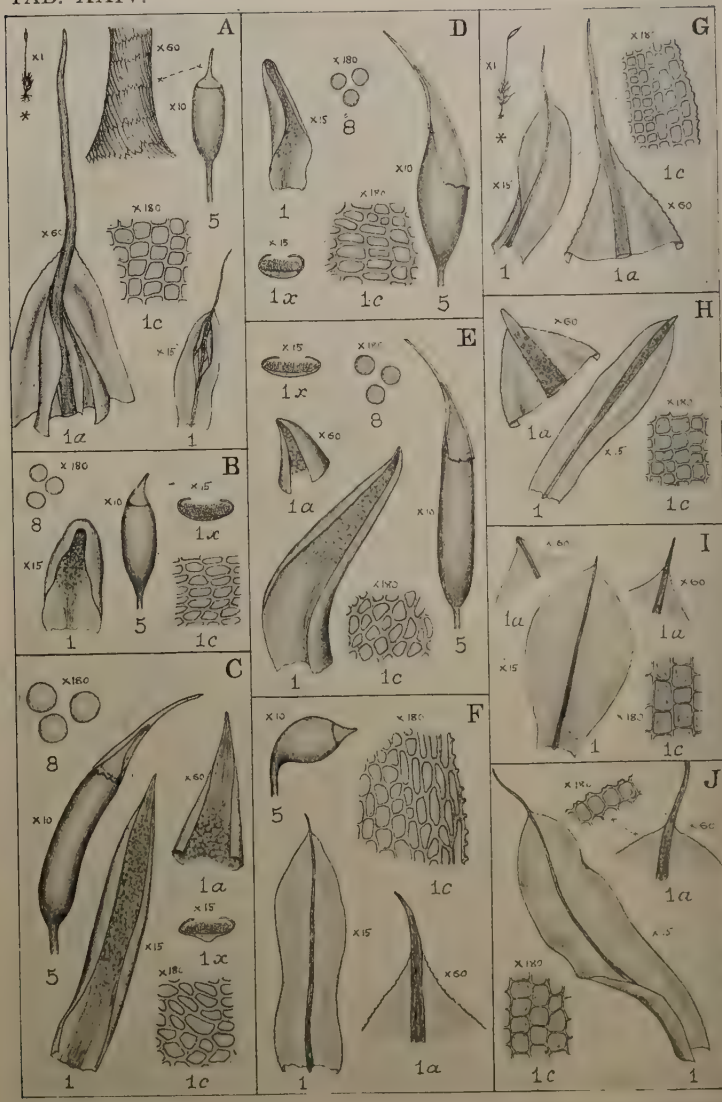


A. Hedwigia ciliata. **B.** H. imberbis. **C.** Acaulon muticum. **D.** A. triquetrum. **E.** Phascum cuspidatum. **F.** P. Floerkeanum. **G.** P. curvicolle. **H.** Pottia recta. **I.** P. bryoides. **J.** P. Heimii. **K.** P. truncatula.

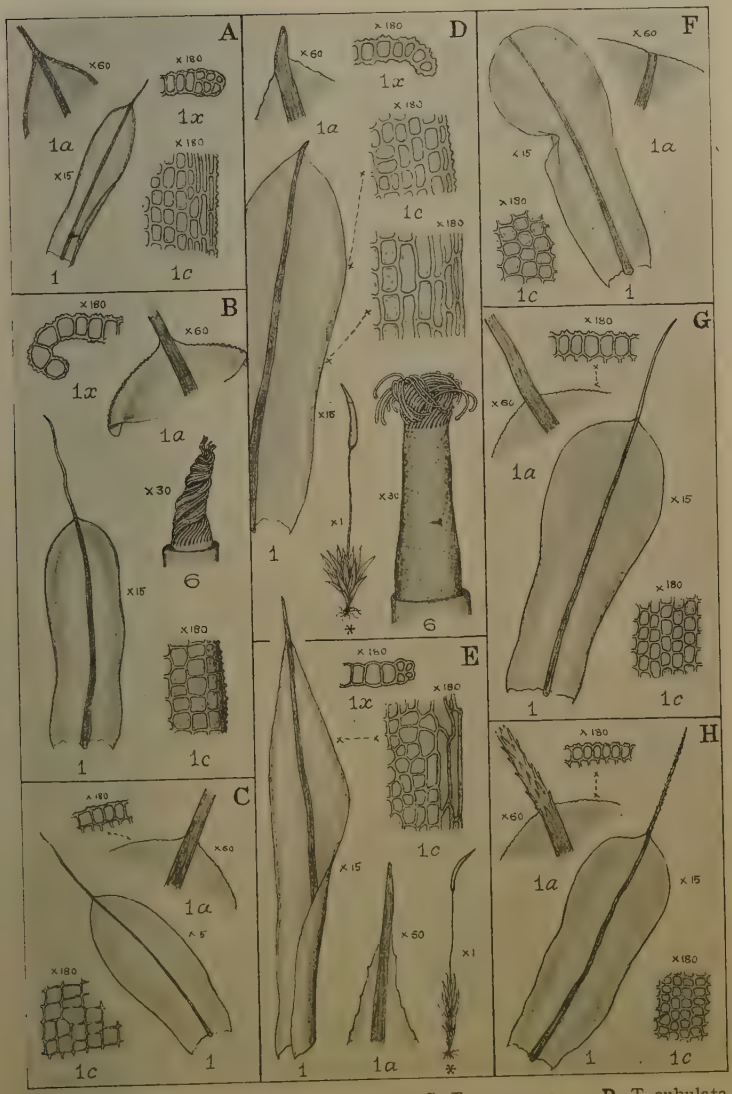


A. Pottia intermedia. **B.** P. crinita. **C.** P. Wilsoni. **D.** P viridifolia.
E. P. asperula. **F.** P. minutula. **G.** P. Starkeana. **H.** P. commutata.
I. P. caespitosa. **J.** P. lanceolata. **K.** P. latifolia. **L.** Tortula pusilla.

TAB. XXIV.

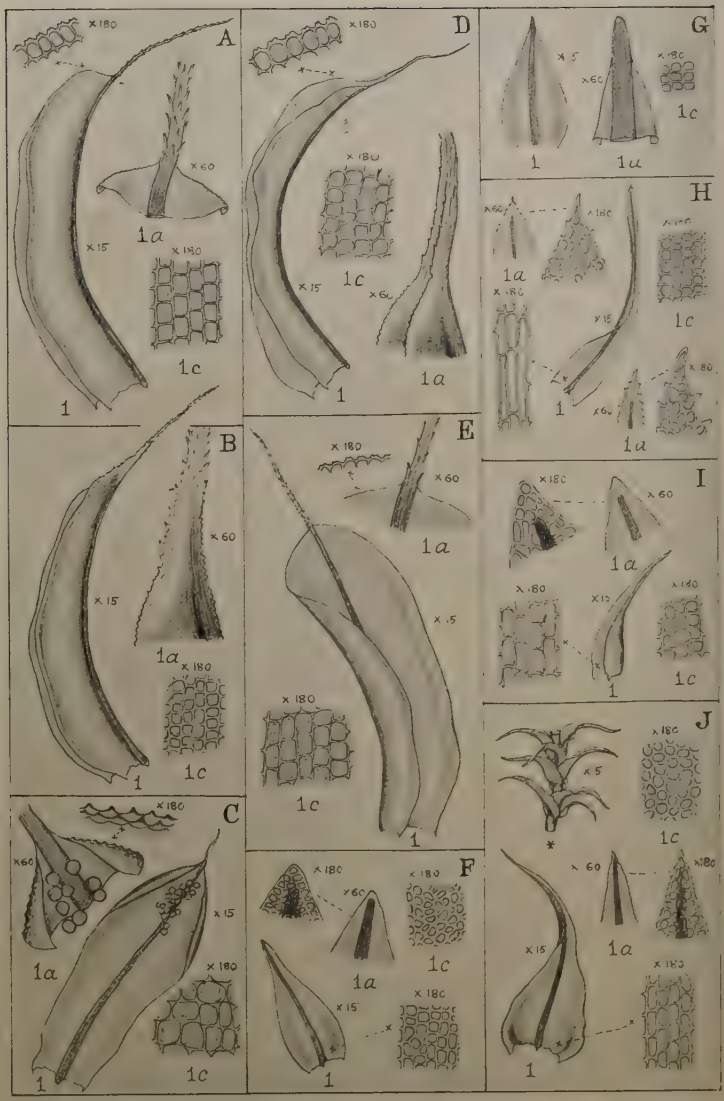


A Tortula lamellata. **B.** T. brevirostris. **C.** T. aloides. **D.** T. rigida.
E. T. ambigua. **F.** T. cernua. **G.** T. suberecta. **H.** T. atrovirens.
I. T. cuneifolia. **J.** T. Vahliana.

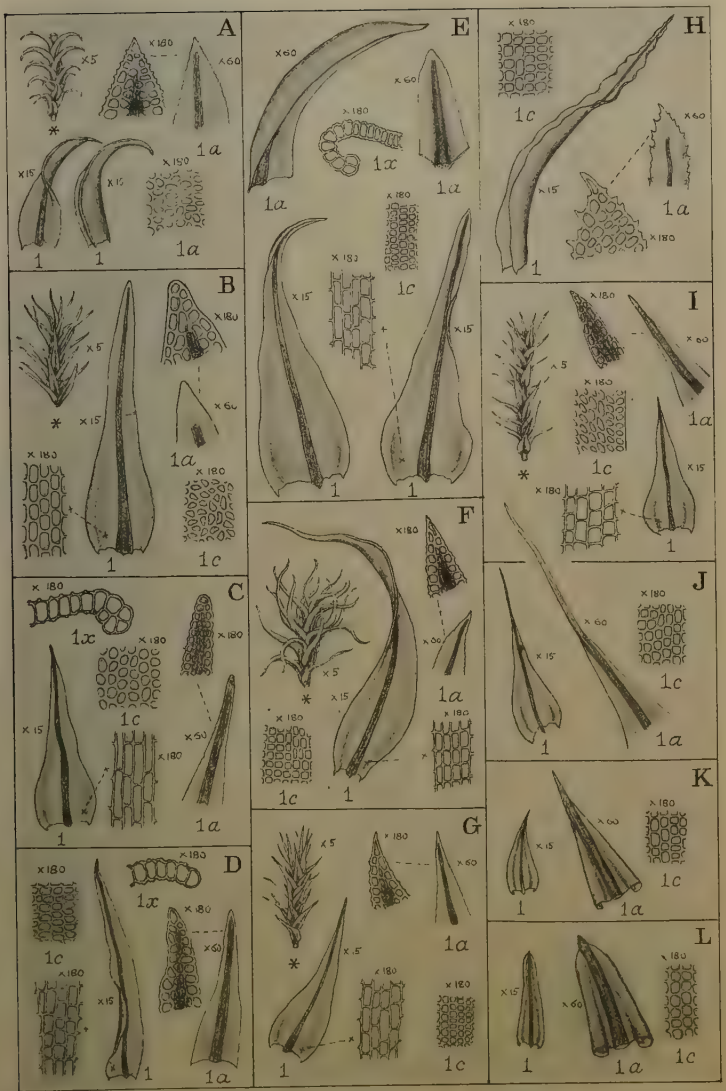


A. Tortula marginata. **B.** T. muralis. **C.** T. canescens. **D.** T. subulata.
E. T. angustata. **F.** T. mutica. **G.** T. laevipila. **H.** T. intermedia.

TAB. XXVI.

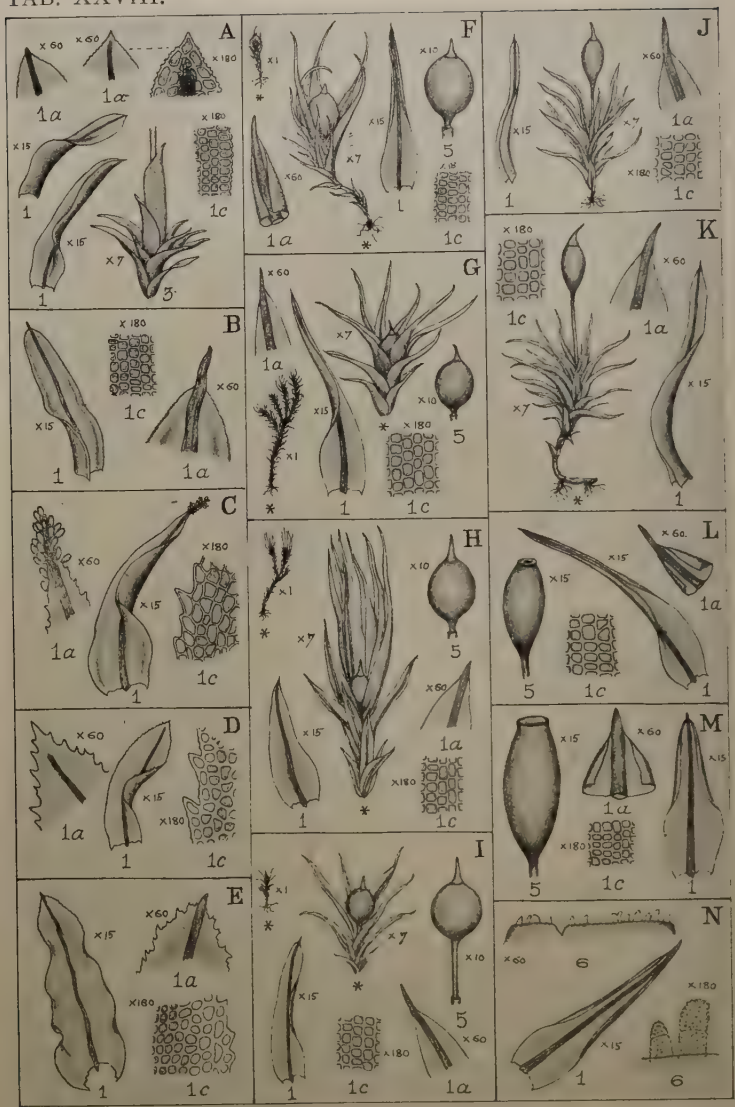


A. Tortula ruralis. **B.** T. ruraliformis. **C.** T. papillosa. **D.** T. norvegica.
E. T. princeps. **F.** Barbula lurida. **G.** B. cordata. **H.** B. rubella.
I. B. tophacea. **J.** B. fallax.

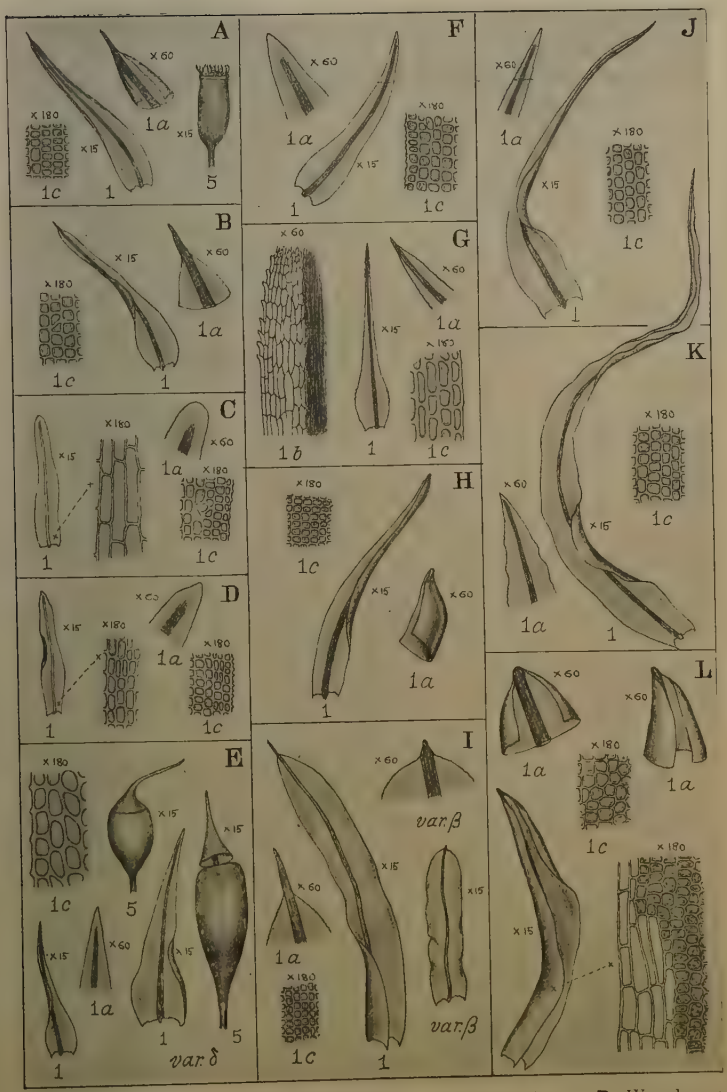


A. Barbula recurvifolia. **B.** B. spadicea. **C.** B. rigidula. **D.** B. glauca.
E. B. Nicholsoni. **F.** B. cylindrica. **G.** B. vinealis. **H.** B. sinuosa. **I.** B. gracilis.
J. B. icmadophila. **K.** B. Hornschuchiana. **L.** B. revoluta.

TAB. XXVIII.

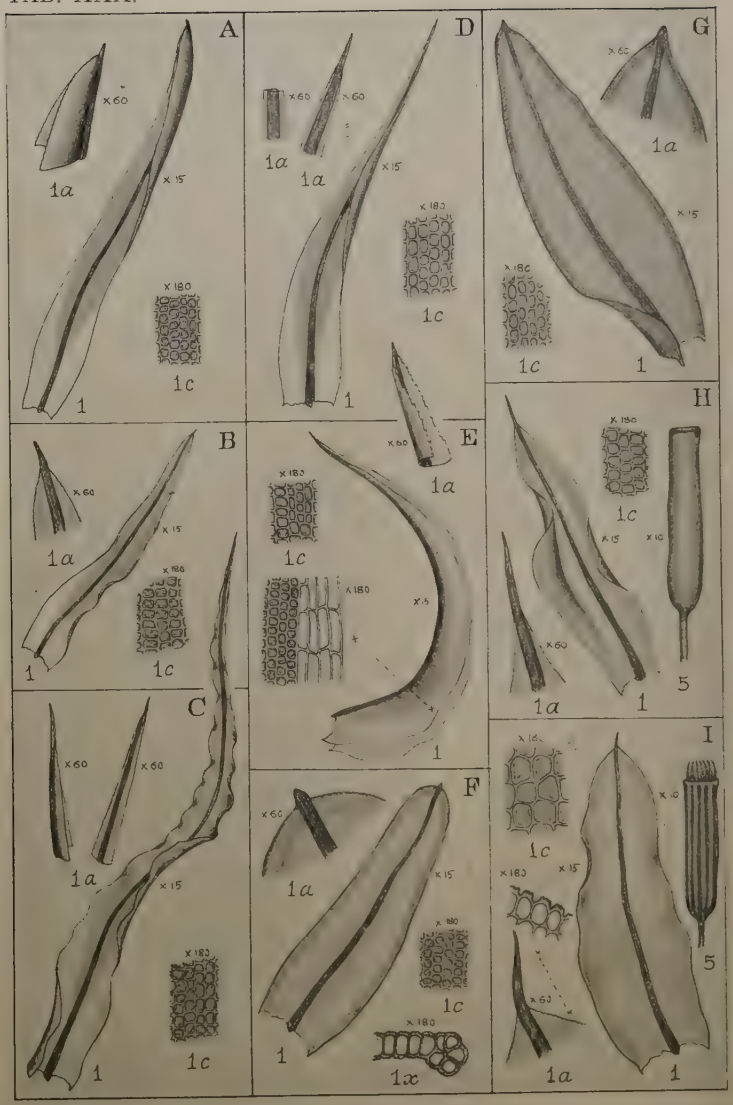


A. Barbula convoluta. **B.** B. unguiculata. **C.** Leptodontium gemmascens.
D. L. flexifolium. **E.** L. recurvifolium. **F.** Weisia crispa. **G.** W. sterilis.
H. W. multicapsularis. **I.** W. Mittenii. **J.** W. rostellata. **K.** W. squarrosa.
L. W. microstoma. **M.** W. tortilis. **N.** W. crispata.

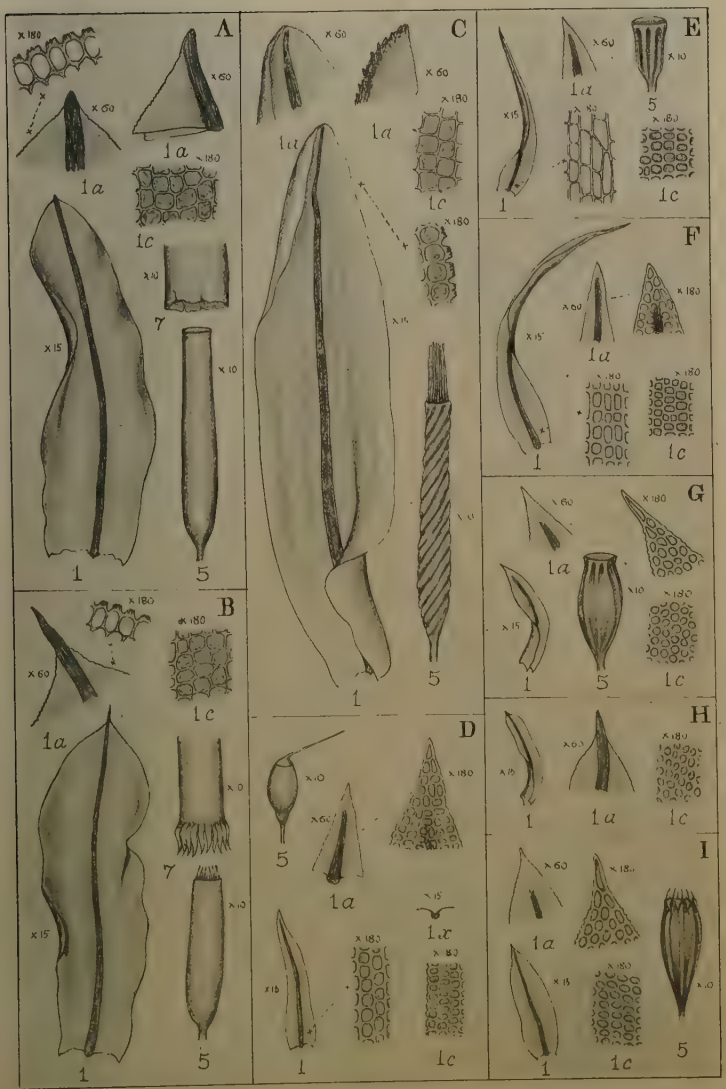


A. Weisia viridula. **B.** W. mucronata. **C.** W. tenuis. **D.** W. calcarea.
E. W. curvirostris. **F.** W. rupestris. **G.** W. verticillata.
H. Trichostomum crispulum. **I.** T. mutabile. **J.** T. hibernicum.
K. T. tenuirostre. **L.** T. flavovirens.

TAB. XXX.

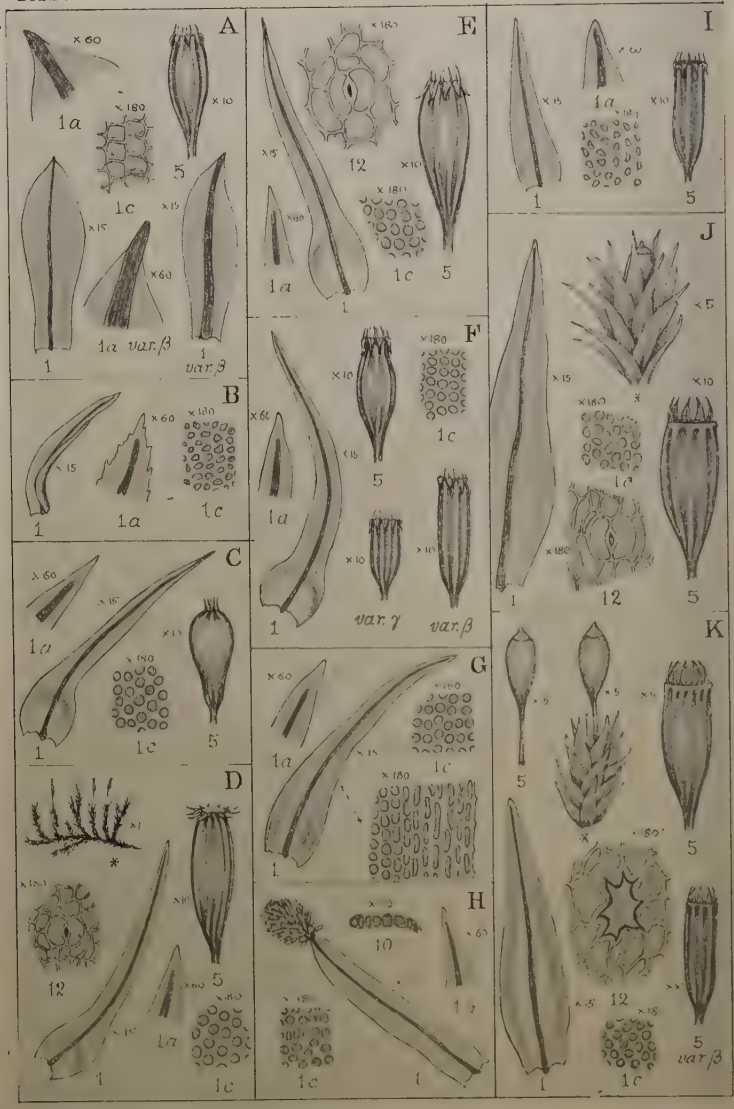


A. Trichostomum inclinatum. **B.** T. nitidum. **C.** T. tortuosum. **D.** T. fragile.
E. Pleurochaete squarrosa. **F.** Cinclidotus Brebissoni. **G.** C. fontinaloides.
H. Encalypta commutata. **I.** E. rhabdocarpa.

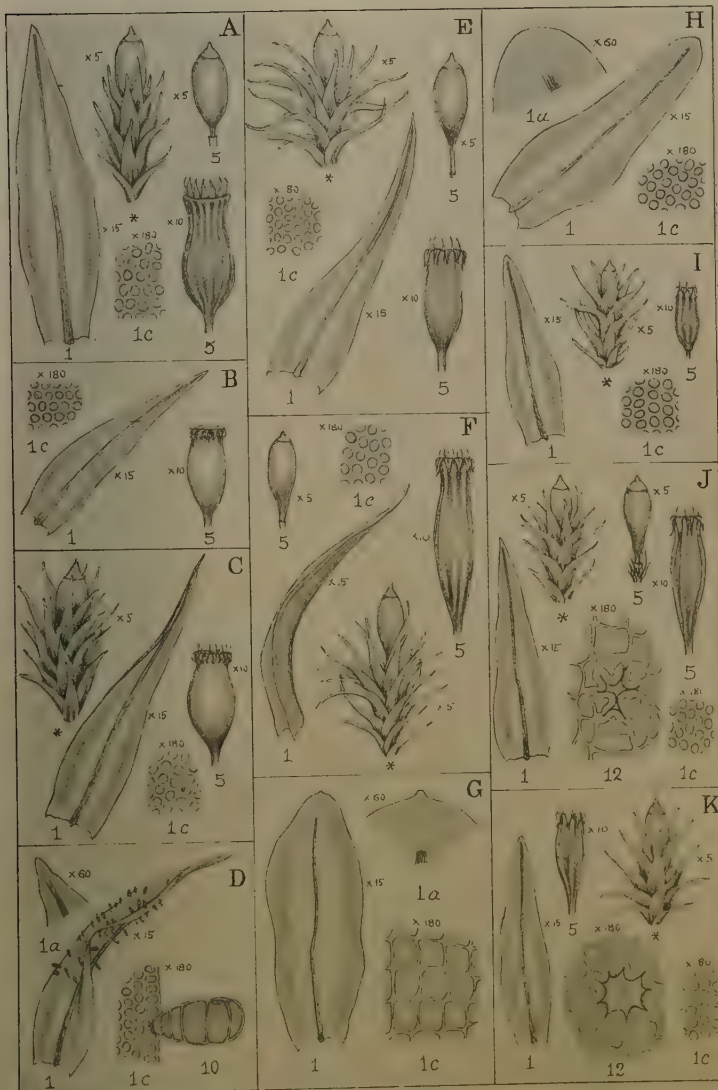


A. Encalypta vulgaris. **B.** E. ciliata. **C.** E. streptocarpa.
D. Anoectangium compactum. **E.** Zygodon lapponicus. **F.** Z. Mougeotii.
G. Z. viridissimus. **H.** Z. Stirtoni. **I.** Z. conoideus.

TAB. XXXII.

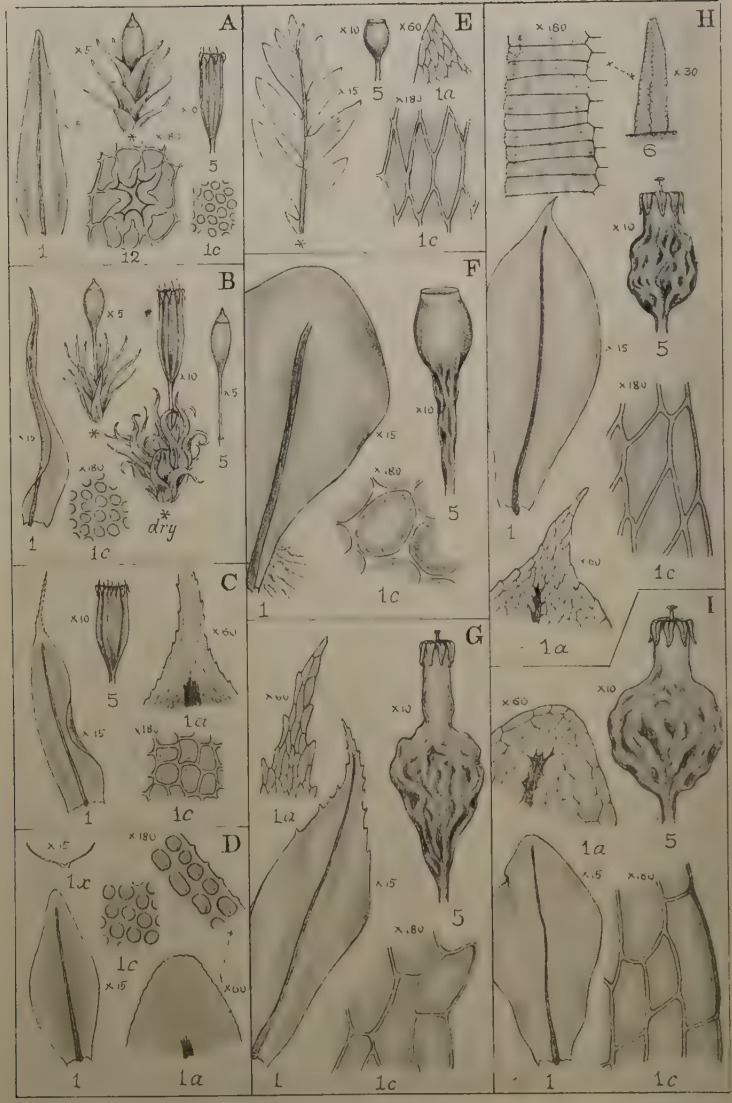


A. Zygodon Forsteri. **B.** Z. gracilis. **C.** Ulota Ludwigii. **D.** U. Drummondii.
E. U. Bruchii. **F.** U. crispa. **G.** U. vittata. **H.** U. phyllantha.
I. U. Hutchinsiae. **J.** Orthotrichum rupestre. **K.** O. anomalum.

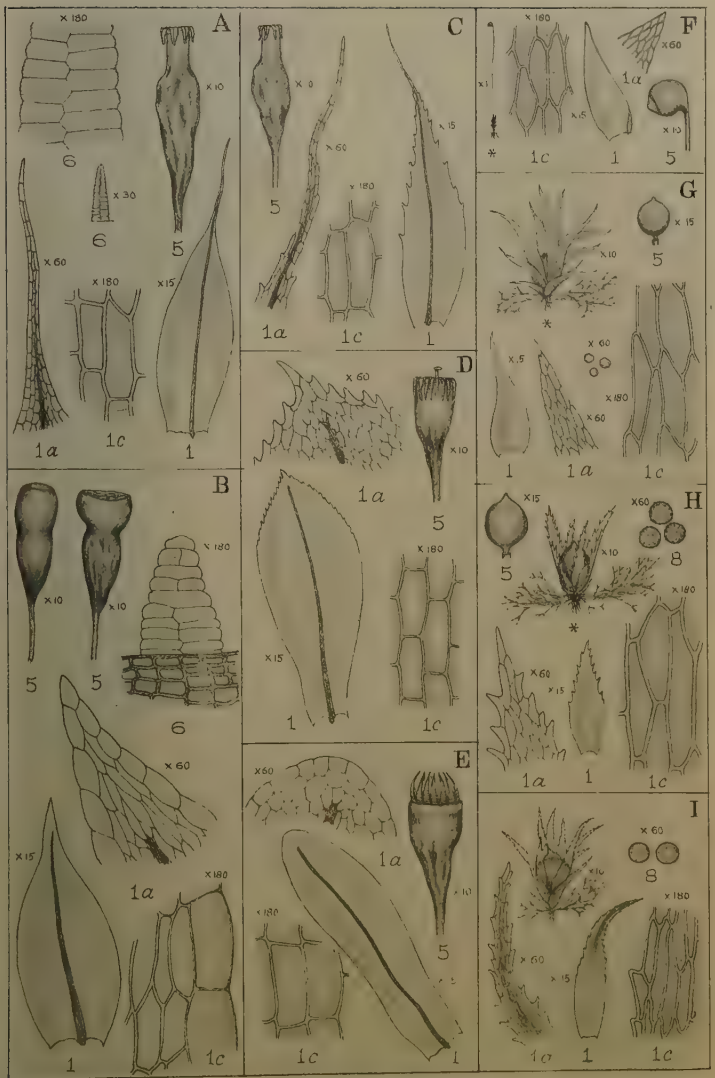


A. Orthotrichum cupulatum. **B.** O. Shawii. **C.** O. leiocarpum. **D.** O. Lyellii.
E. O. speciosum. **F.** O. affine. **G.** O. Sprucei. **H.** O. rivulare.
I. O. Schimperi. **J.** O. stramineum. **K.** O. pallens.

TAB. XXXIV.



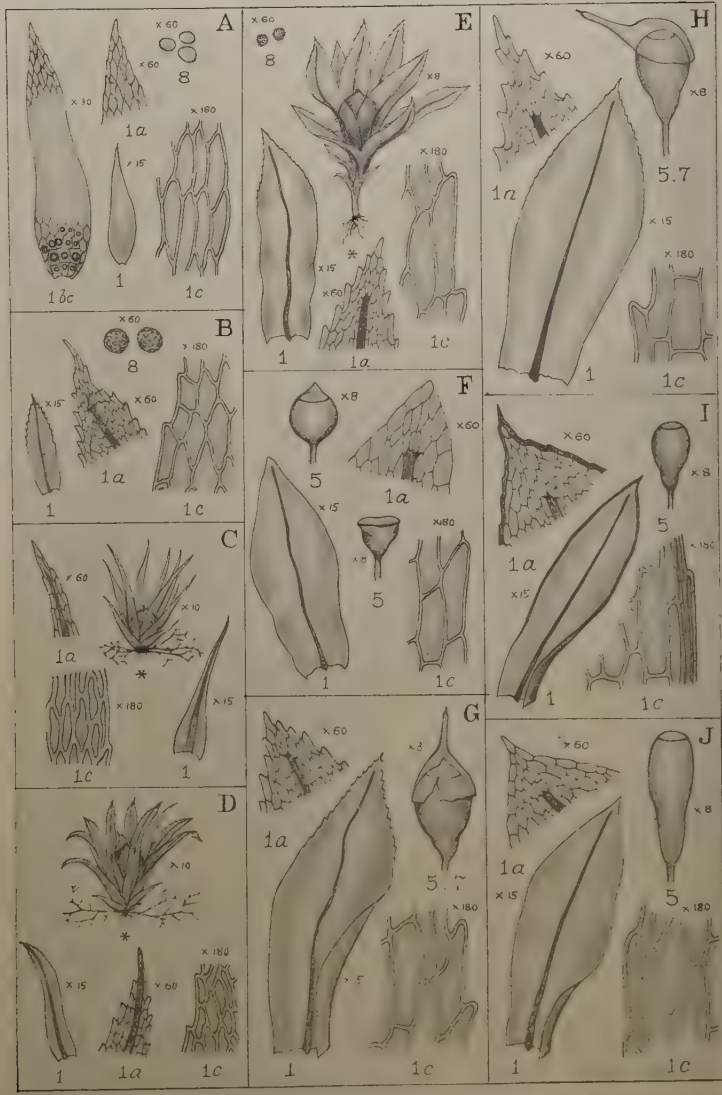
A. Orthotrichum tenellum. **B.** O. pulchellum. **C.** O. diaphanum.
D. O. obtusifolium. **E.** Schistostega osmundacea. **F.** Oedipodium Griffithianum.
G. Splachnum ampullaceum. **H.** S. sphaericum. **I.** S. vasculosum.



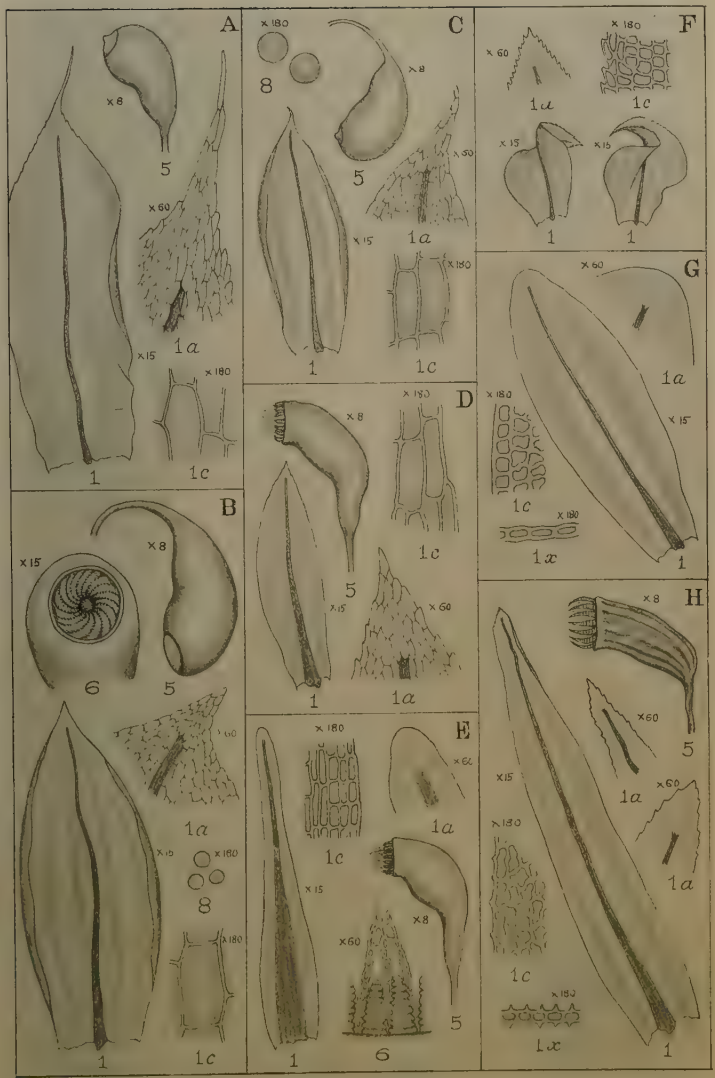
A. Tetraplodon mnioides.
B. T. Wormskjoldii.
C. T. angustatus.
D. Tayloria tenuis.
E. T. lingulata.
F. Discelium nudum.
G. Nanomitrium tenerum.
H. Ephemerum serratum
I. E. intermedium.

c

TAB. XXXVI.

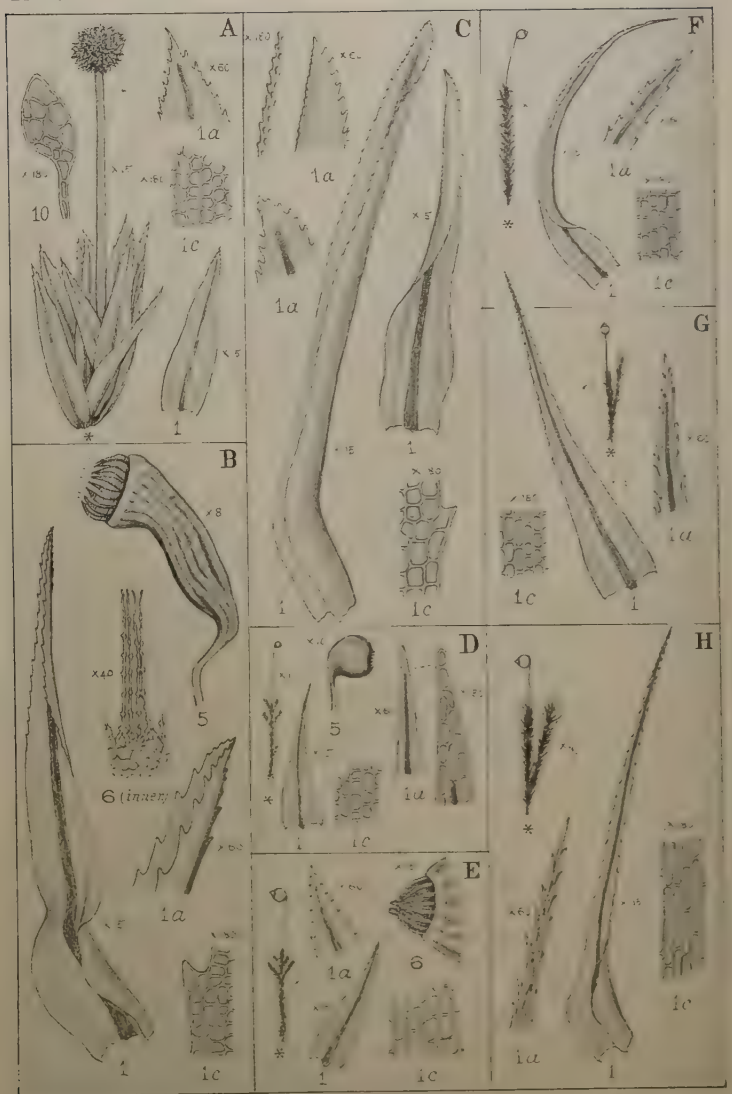


A. Ephemerum stellatum. **B.** E. cohaerens. **C.** E. sessile. **D.** E. recurvifolium.
E. Physcomitrella patens. **F.** Physcomitrium sphaericum. **G.** P. pyriforme.
H. Funaria fascicularis. **I.** F. ericetorum. **J.** F. Templetoni.

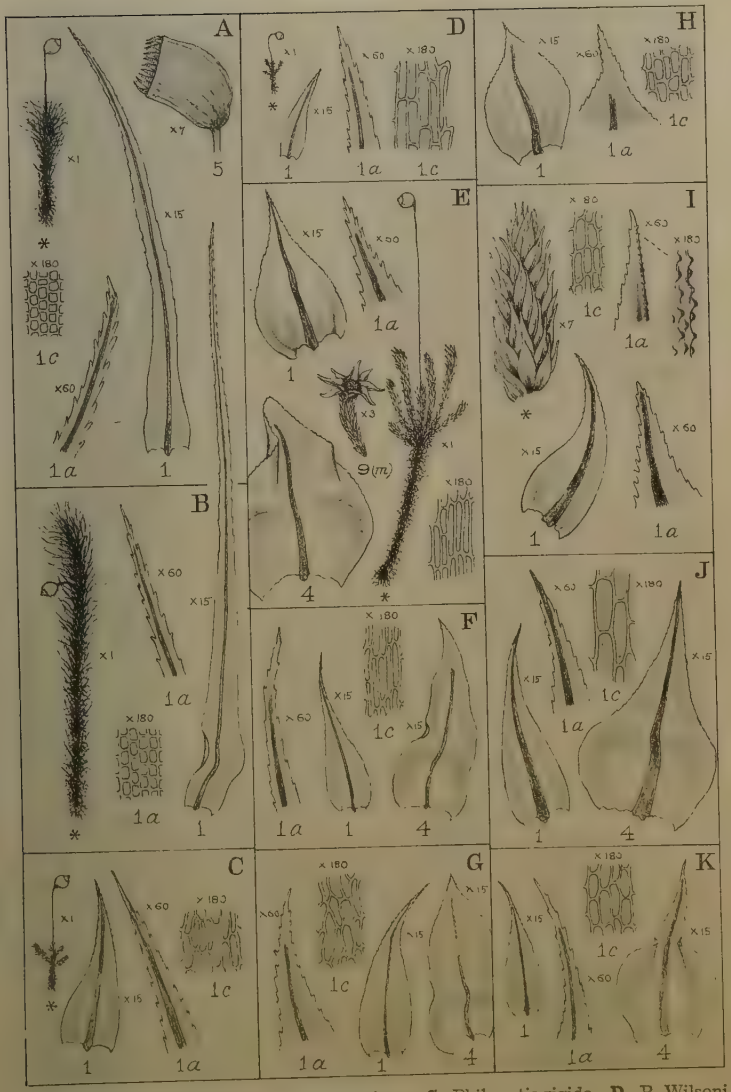


A. Funaria calcarea. **B.** F. hygrometrica. **C.** F. microstoma.
D. Amblyodon dealbatus. **E.** Meesia trichoides. **F.** Paludella squarrosa.
G. Aulacomnium turgidum. **H.** A. palustre.

TAB. XXXVIII.

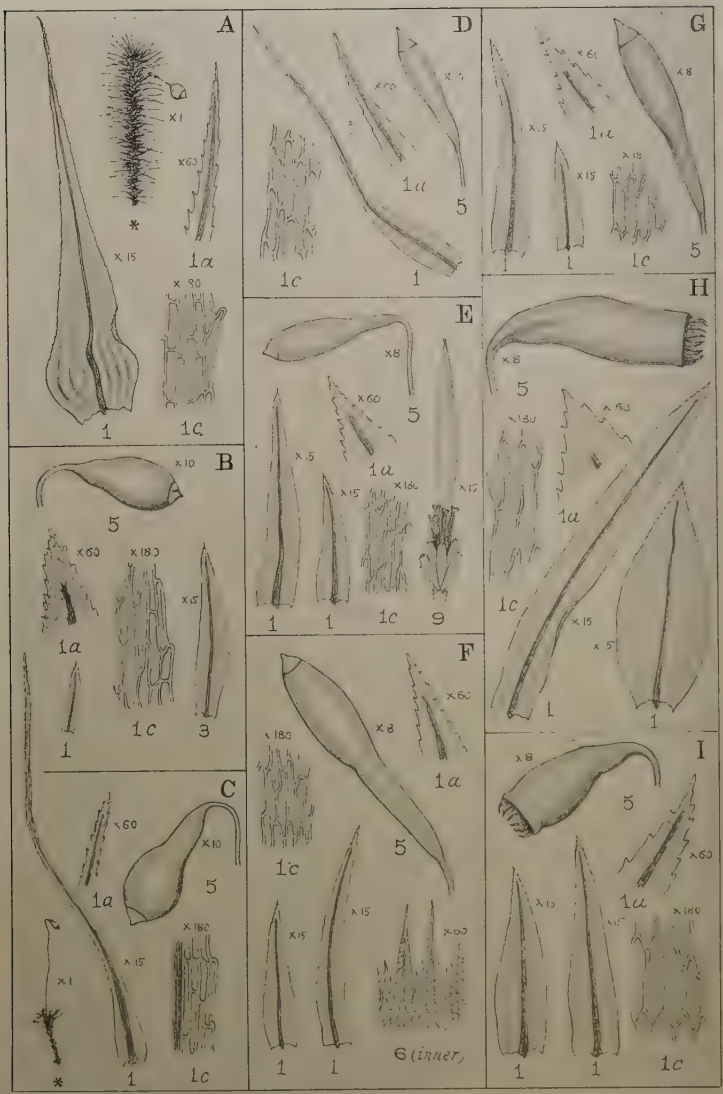


A. Aulacomnium androgynum. **B.** Timmia austriaca. **C.** T. norvegica
D. Catoscopium nigritum. **E.** Conostomum boreale. **F.** Bartramia Oederi
G. B. stricta. **H.** B. ithyphylla.

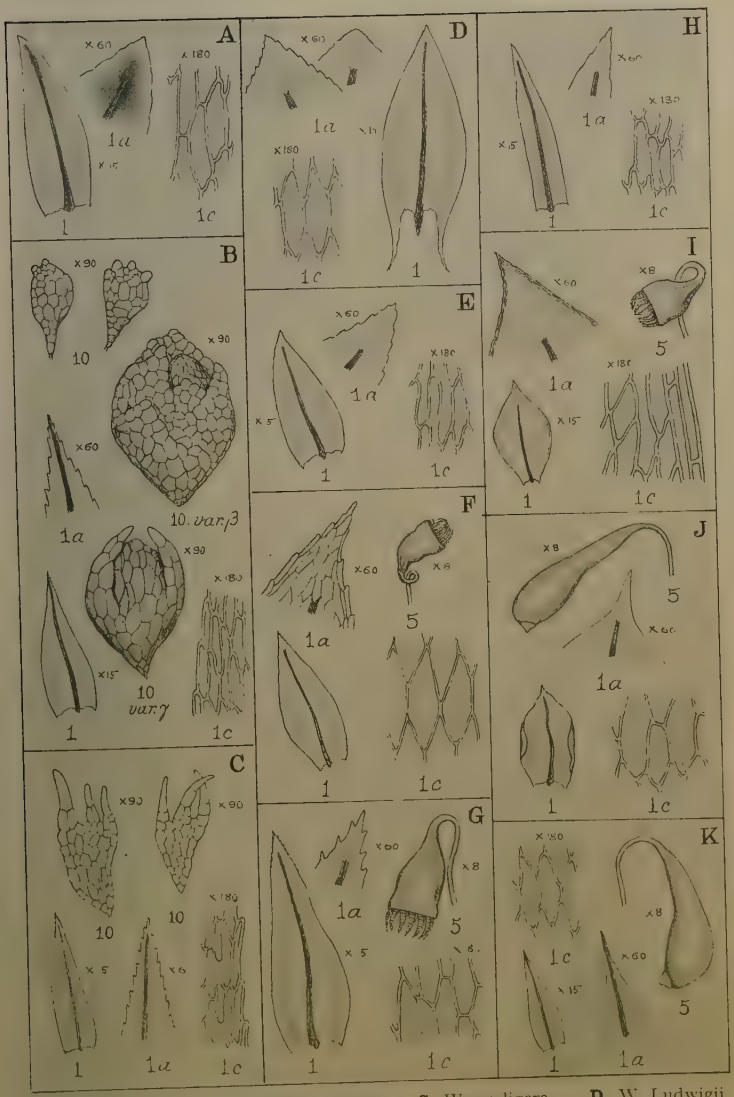


A. Bartramia pomiformis. **B.** B. Halleriana. **C.** Philonotis rigida. **D.** P. Wilsoni. **E.** P. fontana. **F.** do. *var.* tomentella. **H.** do. *var.* adpressa. **G.** P. caespitosa. **I.** P. seriata. **J.** P. calcarea. **K.** P. capillaris.

TAB. XL.

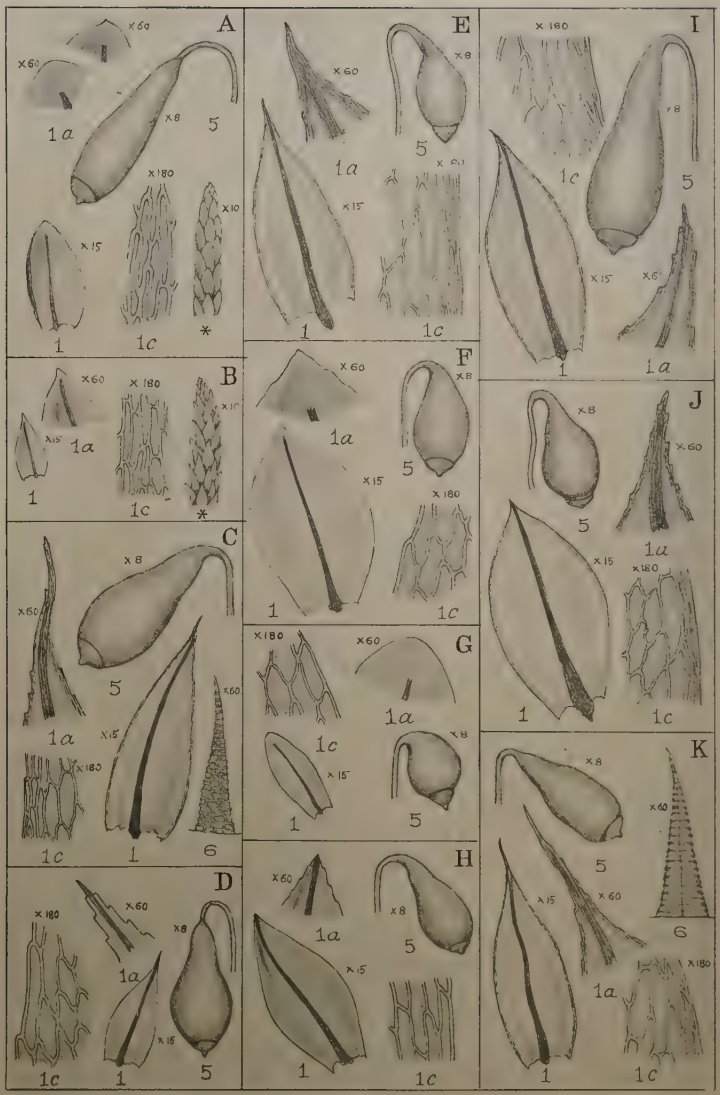


A. Breutelia arcuata. **B.** Oreas Mielichoferi. **C.** Leptobryum pyriforme.
D. Orthodontium gracile. **E.** Webera polymorpha. **F.** W. elongata.
G. W. acuminata. **H.** W. cruda. **I.** W. nutans.

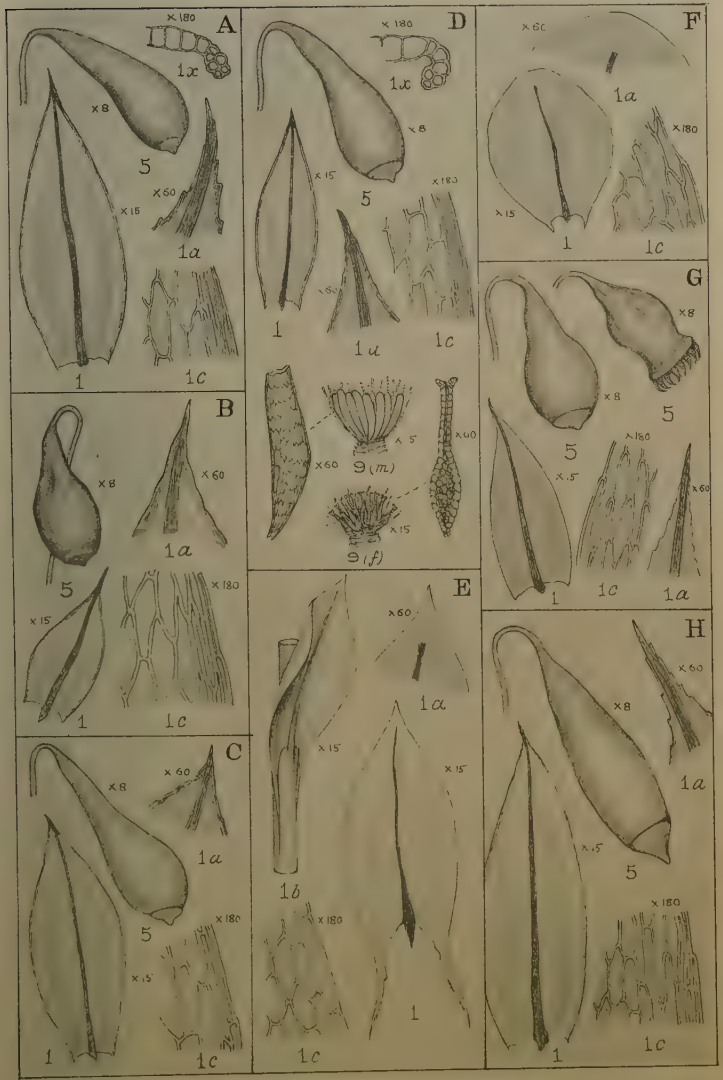


A. Webera cucullata. **B.** W. annotina. **C.** W. proligera. **D.** W. Ludwigii.
E. W. commutata. **F.** W. carnea. **G.** W. albicans. **H.** W. gracilis. **I.** W. Tozeri.
J. Plagiobryum Zierii. **K.** P. demissum.

TAB. XLII.

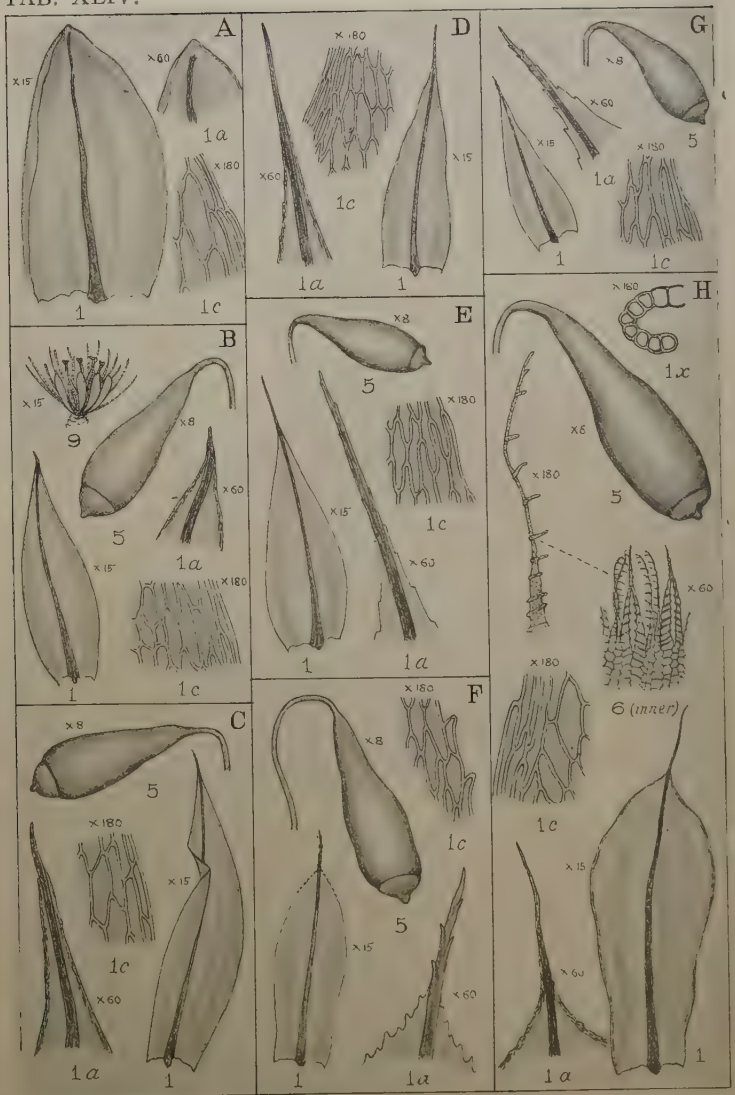


A. Bryum filiforme. **B.** B. concinnatum. **C.** B. pendulum. **D.** B. Warneum.
E. B. arcticum. **F.** B. calophyllum. **G.** B. Marratii. **H.** B. lacustre.
I. B. purpureum. **J.** B. mamillatum. **K.** B. inclinatum.

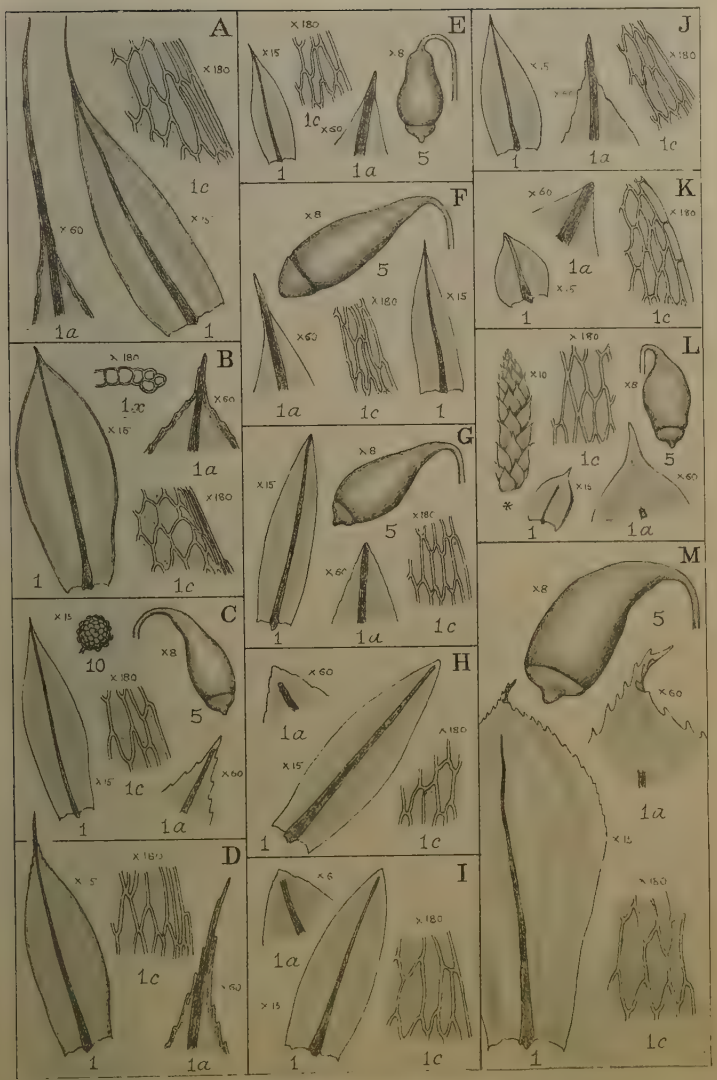


A. Bryum uliginosum. **B.** B. lawersianum. **C.** B. fallax. **D.** B. pallens. **E.** B. Duvalii. **F.** B. cyclophyllum. **G.** B. turbinatum. **H.** B. pseudotriquetrum.

TAB. XLIV.

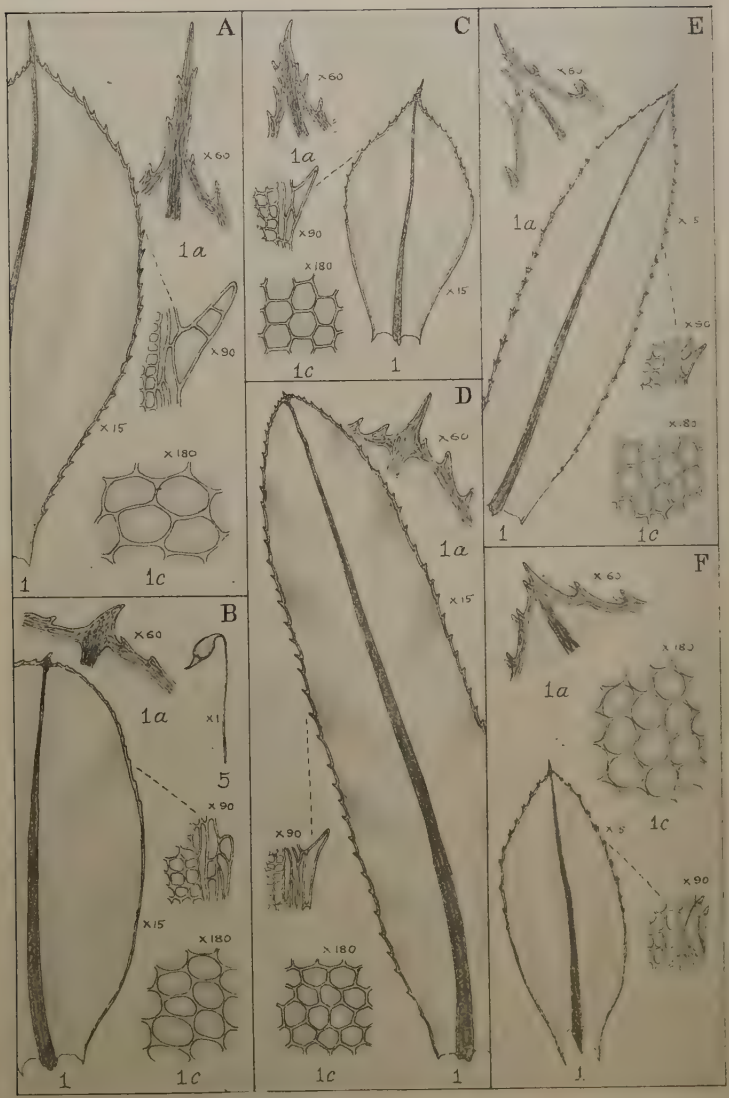


A. Bryum neodamense. **B.** B. bimum. **C.** B. affine. **D.** B. pallescens.
E. B. caespiticium. **F.** B. provinciale. **G.** B. intermedium. **H.** B. capillare.

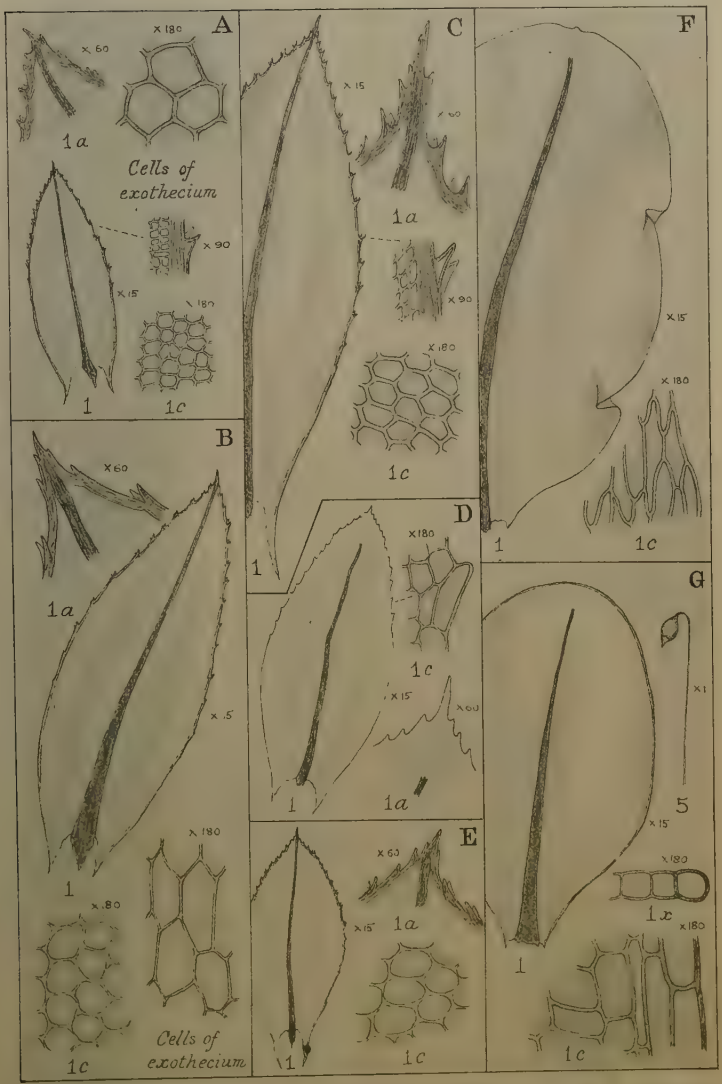


A. Bryum obconicum. **B.** B. Donianum. **C.** B. erythrocarpum. **D.** B. rubens.
E. B. atropurpureum. **F.** B. murale. **G.** B. alpinum. **H.** B. gemmiparum.
I. B. Muehlenbeckii. **J.** B. Mildeanum. **K.** B. Dixoni. **L.** B. argenteum.
M. B. roseum.

TAB. XLVI.

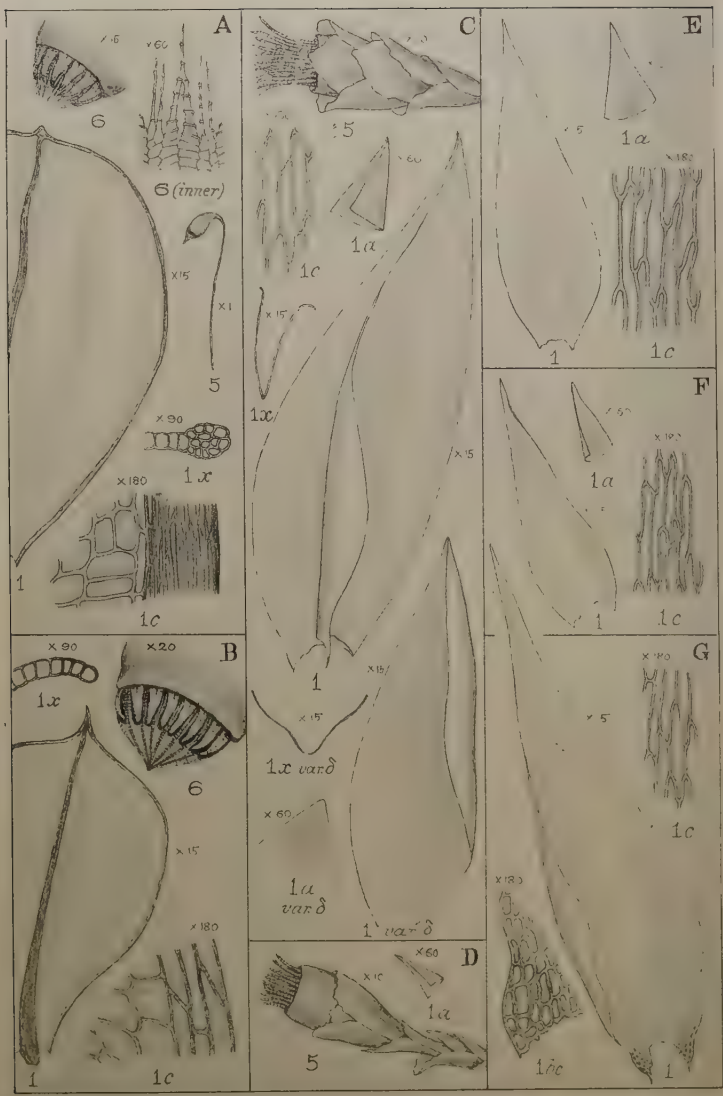


A. Mnium affine. **B.** M. rostratum. **C.** M. cuspidatum. **D.** M. undulatum. **E.** M. hornum. **F.** M. serratum.

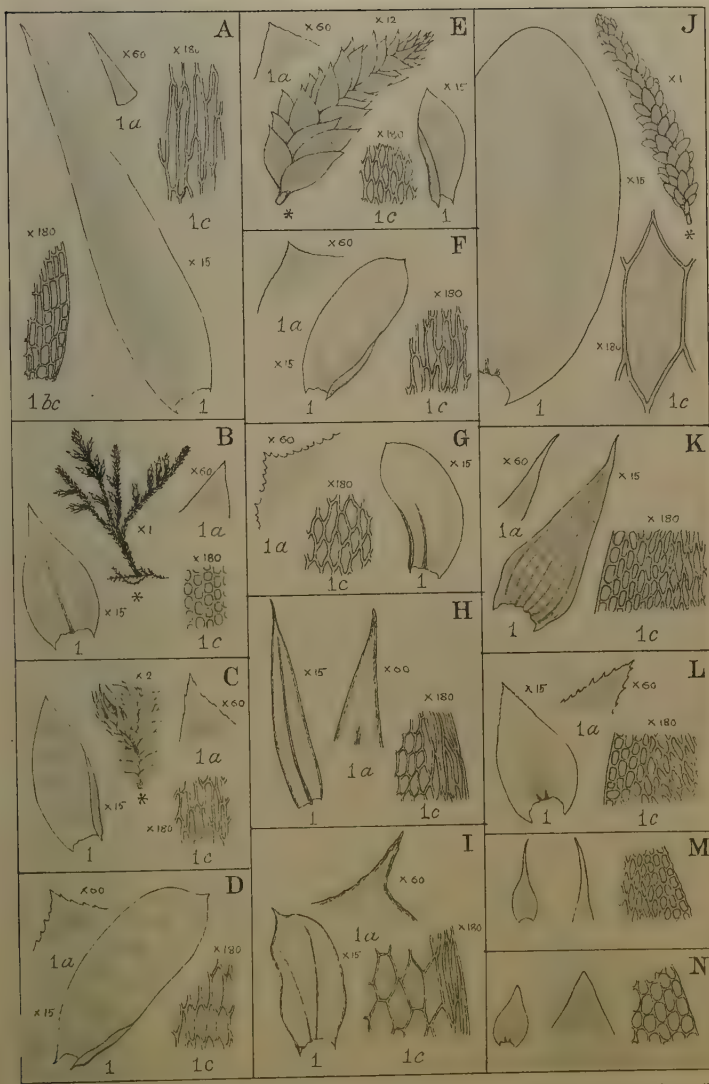


A. Mnium orthorrhynchum. **B.** M. lycopodioides. **C.** M. spinosum.
D. M. stellare. **E.** M. riparium. **F.** M. cinclidioides. **G.** M. subglobosum.

TAB. XLVIII.

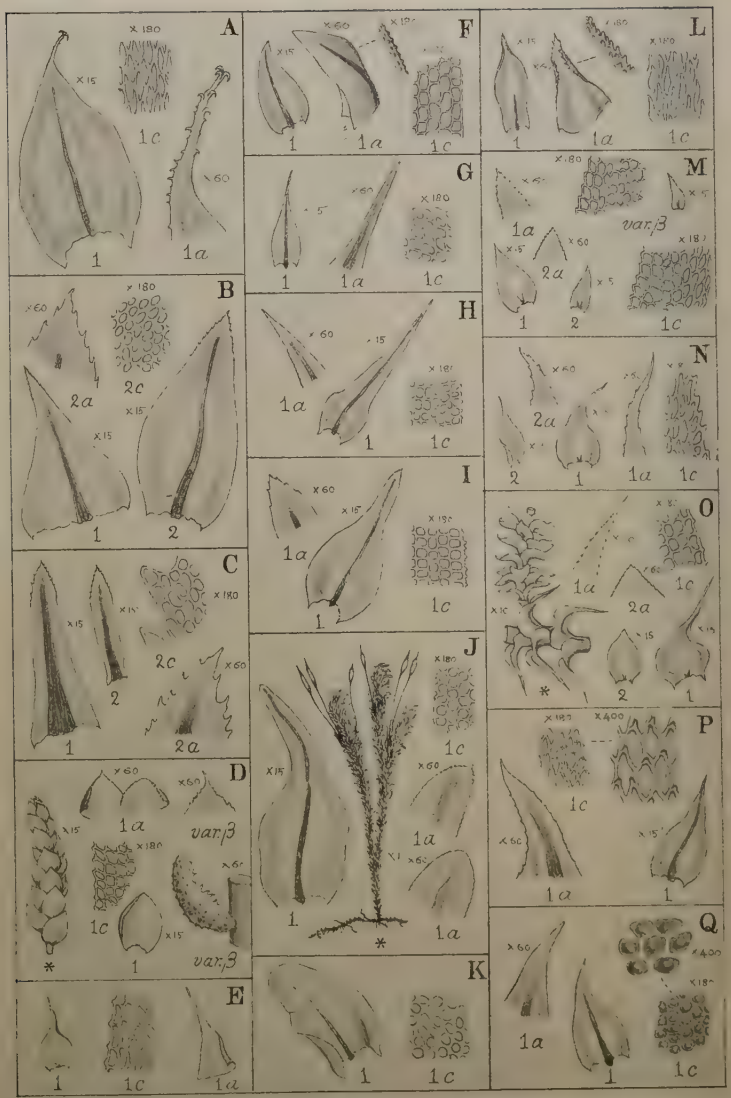


A. Mnium punctatum. **B.** Cinclidium stygium. **C.** Fontinalis antipyretica.
D. F. dolosa. **E.** F. squamosa. **F.** F. dalecarlica. **G.** F. Dixoni.

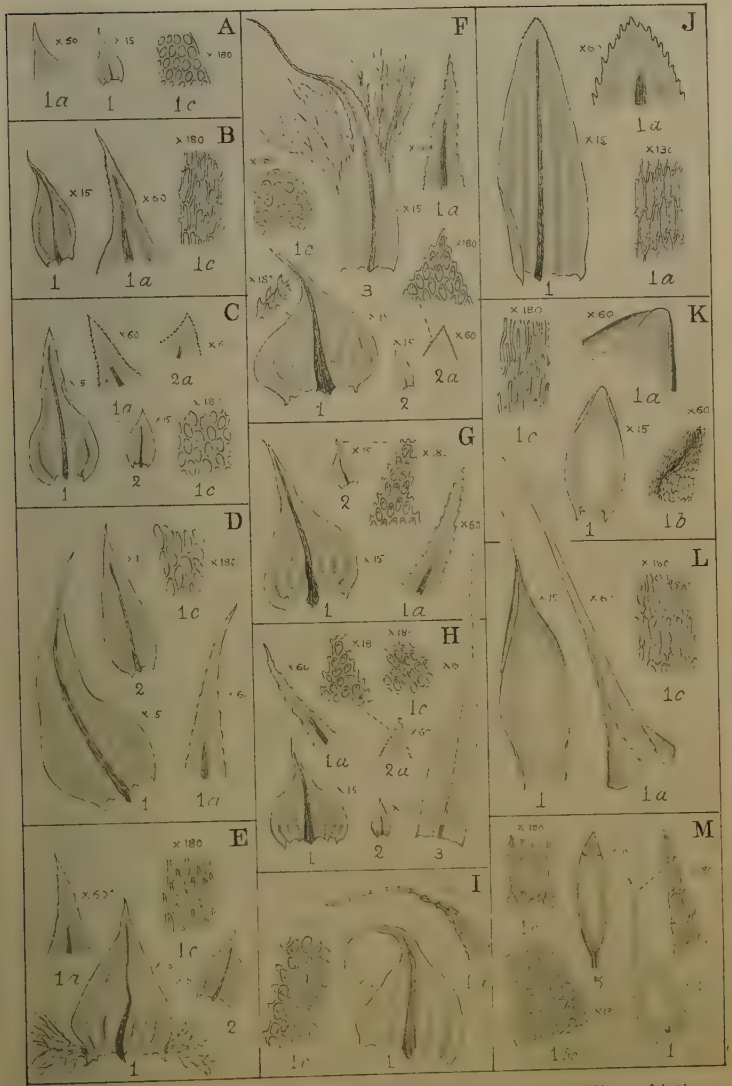


A. Fontinalis seriata. **B.** Cryphaea heteromalla. **C.** Neckera pennata. **D.** N. crispa. **E.** N. pumila. **F.** N. complanata. **G.** Homalia trichomanoides. **H.** Daltonia splachnoides. **I.** Hookeria laete-virens. **J.** Pterygophyllum lucens. **K.** Leucodon sciuroides. **L.** Pterogonium gracile. **M.** Habrodon Notarisii. **N.** Helicodontium pulvinatum.

TAB. L.

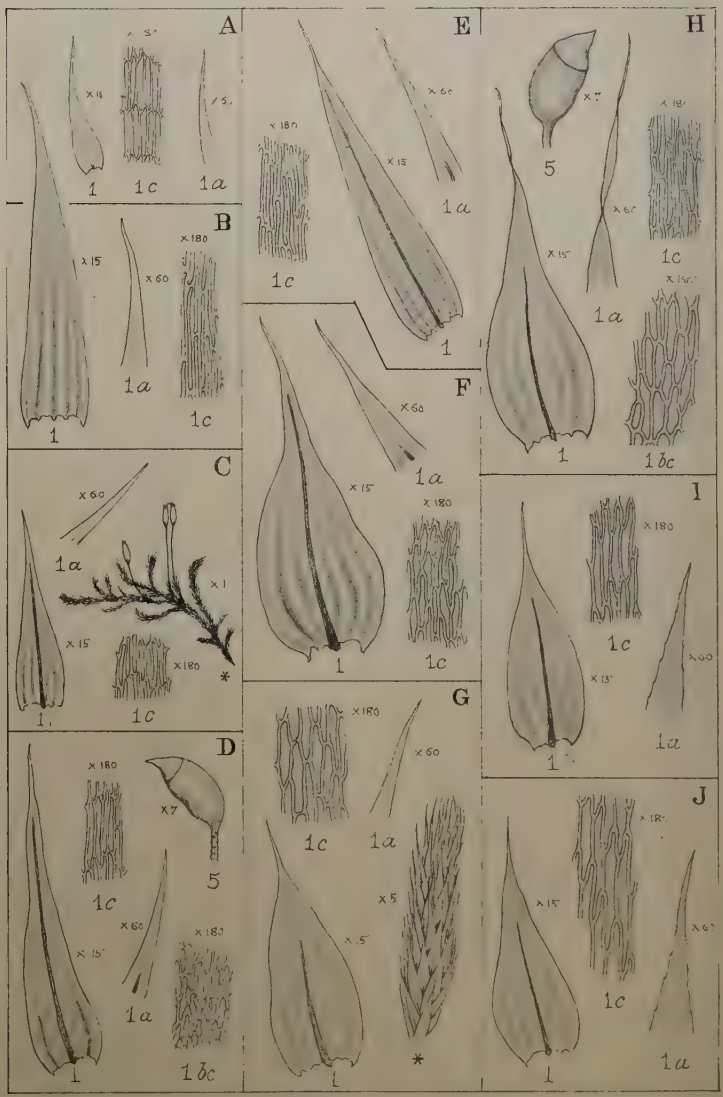


A. Antitrichia curtipendula. **B.** Porotrichum alopecurum. **C.** P. angustifolium. **D.** Myurella julacea. **E.** M. apiculata. **F.** Leskea polycarpa. **G.** L. nervosa. **H.** Anomodon longifolius. **I.** A. attenuatus. **J.** A. viticulosus. **K.** Leptodon Smithii. **L.** Pterigynandrum filiforme. **M.** Heterocladium heteropterum. **N.** H. Macounii. **O.** H. dimorphum. **P.** Pseudoleskea atrovirens. **Q.** P. patens.

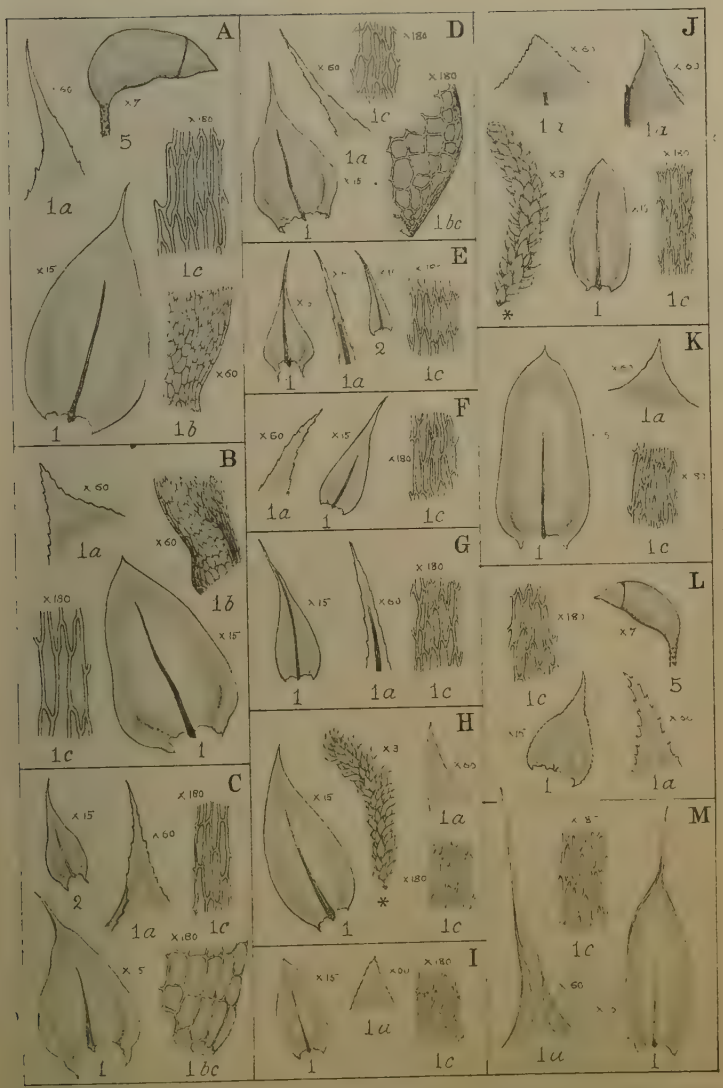


A. Pseudoleskea catenulata. **B.** P. striata. **C.** Thuidium abietinum
D. T. hystricosum. **E.** T. Blandovii. **F.** T. tamariscinum. **G.** T. delicatulum.
H. T. recognitum. **I.** T. Philiberti. **J.** Climacium. dendroides.
K. Cylindrothecium concinnum. **L.** Myurium hebridarum **M.** Pylaisia polyantha.

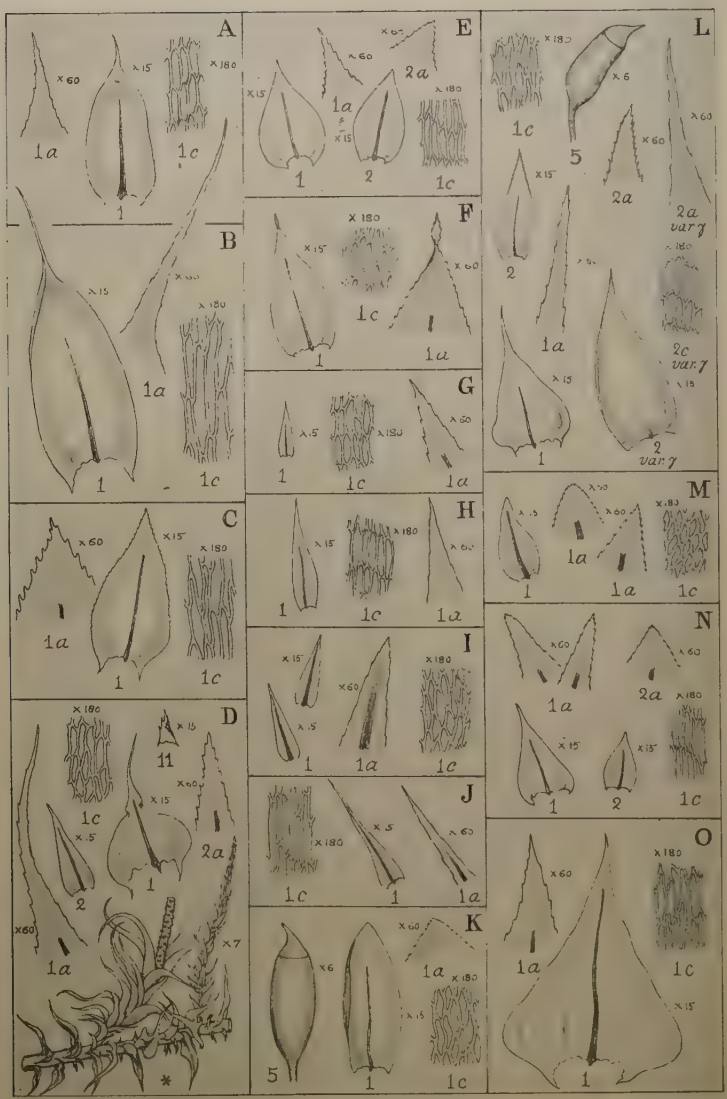
TAB. LII.



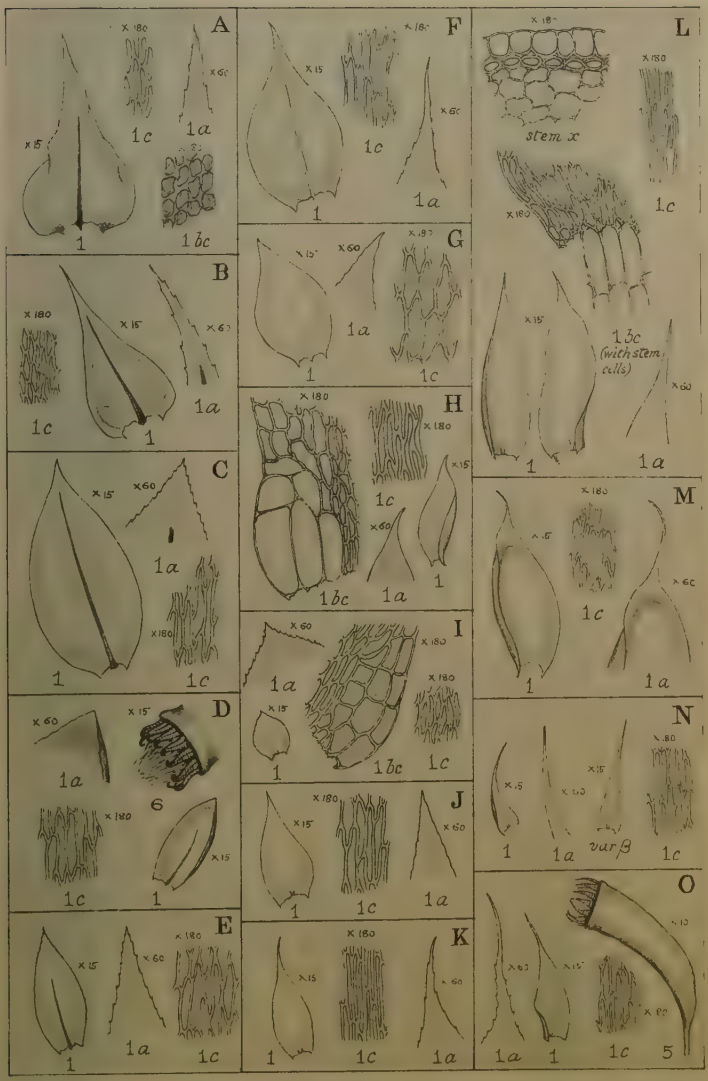
A. Orthothecium intricatum. **B.** O. rufescens. **C.** Camptothecium sericeum.
D. C. lutescens. **E.** C. nitens. **F.** Brachythecium plicatum. **G.** B. albicans
H. B. glareosum. **I.** B. salebrosum. **J.** B. campestre.



A. Brachythecium rutabulum. **B.** B. rivulare. **C.** B Starkei. **D.** B. glaciale.
E. B. reflexum. **F.** B. velutinum. **G.** B. populeum **H.** B plumosum.
I. B. caespitosum. **J.** B. illecebrum. **K.** B. purum. **L.** Hyocomium flagellare.
M. Eurhynchium cirrhosum.

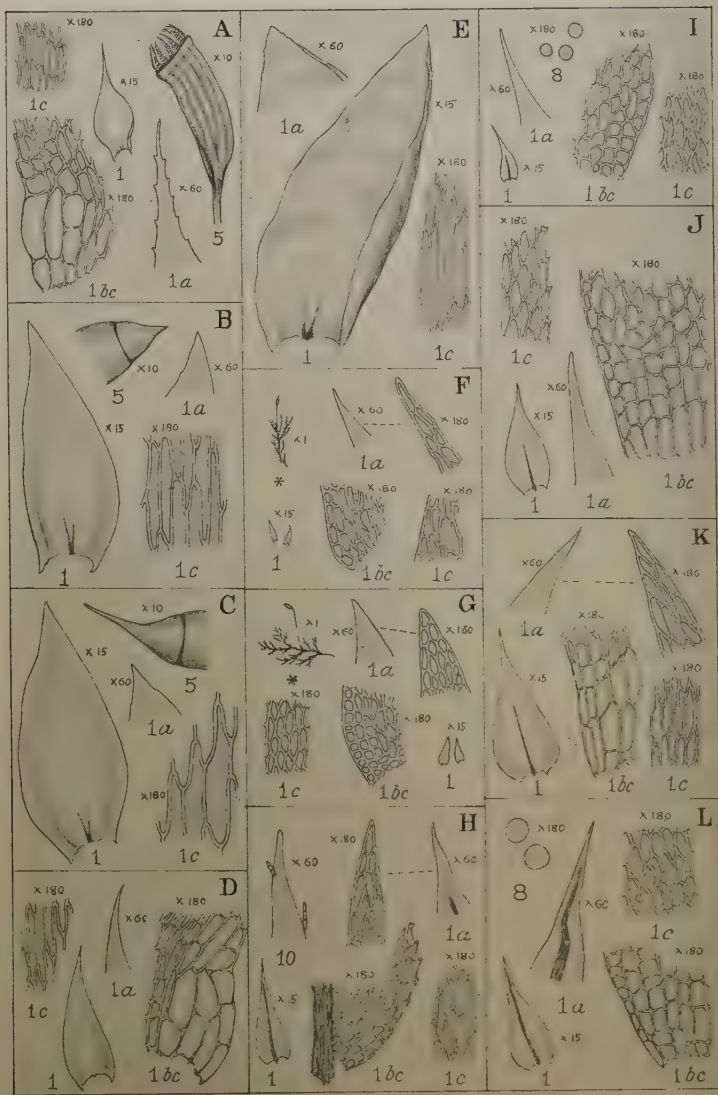


A. Eurhynchium crassinervium. **B.** E. piliferum. **C.** E. speciosum.
D. E. praelongum. **E.** E. Swartzii **F.** E. abbreviatum. **G.** E. pumilum.
H. E. curvisetum. **I.** E. Teesdalii. **J.** E. tenellum. **K.** E. myurum.
L. E. myosuroides. **M.** E. circinatum. **N.** E. strigosum. **O.** E. striatum.

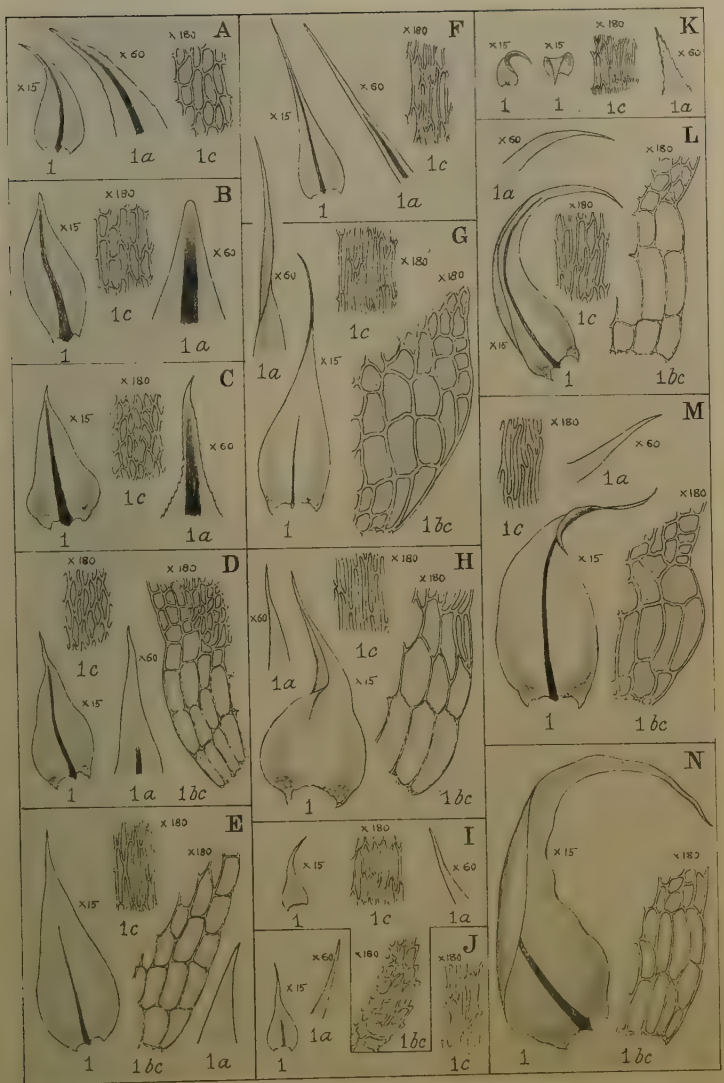


A. Eurhynchium meridionale. **B.** E. striatulum. **C.** E. rusciforme. **D.** E. murale. **E.** E. confertum. **F.** E. megapolitanum. **G.** E. rotundifolium. **H.** Scleropodium demissum. **I.** S. micans. **J.** Plagiothecium depressum. **K.** P. elegans. **L.** P. Muellerianum. **M.** P. piliferum. **N.** P. pulchellum. **O.** P. silesiacum.

TAB. LVI.

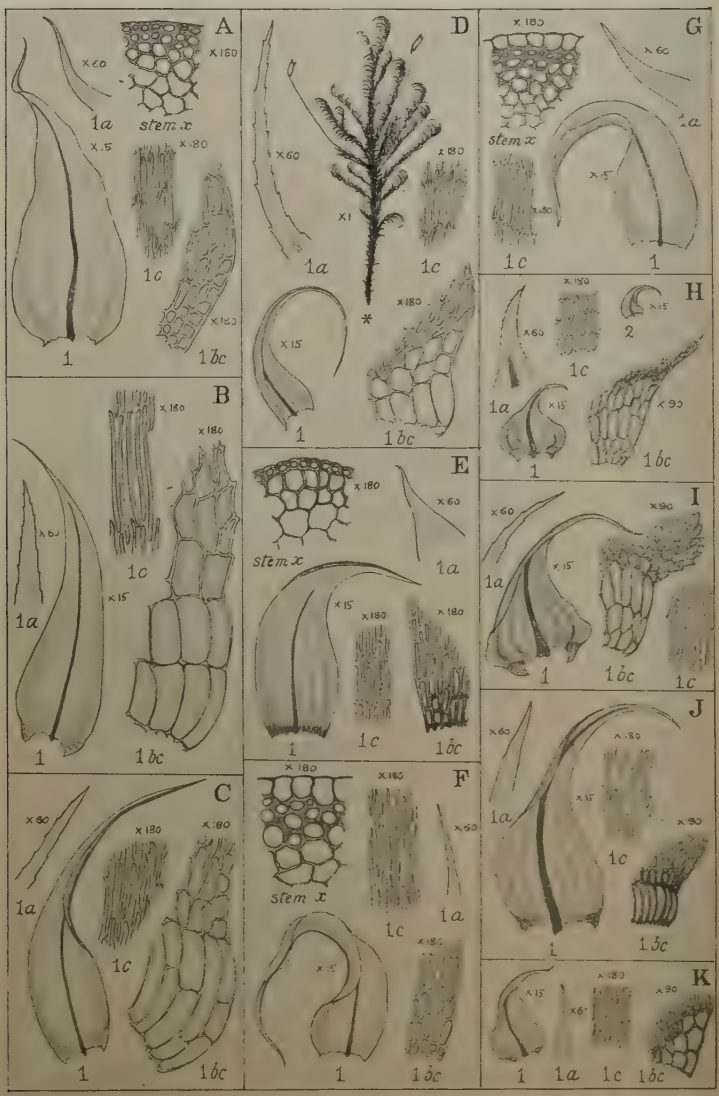


A. Plagiothecium Muehlenbeckii. **B.** P. denticulatum. **C.** P. silvaticum.
D. P. latebricola. **E.** P. undulatum. **F.** Amblystegium Sprucei.
G. A. confervoides. **H.** A. compactum. **I.** A serpens. **J.** A. Juratzkanum.
K. A. Kochii. **L.** A. varium.

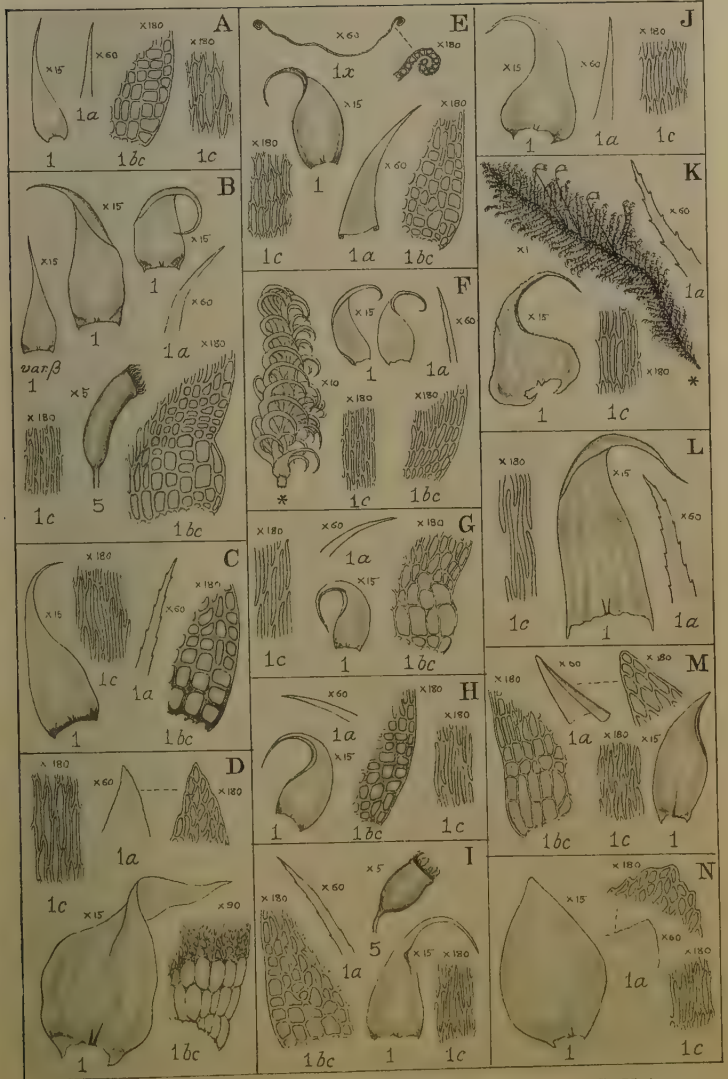


A. Amblystegium irriguum. **B.** A. fluviatile. **C.** A. filicinum. **D.** A. curvicaule. **E.** Hypnum riparium. **F.** H. elodes. **G.** H. polygamum. **H.** H. stellatum. **I.** H. hispidulum, *var.* Sommerfeltii. **J.** H. chrysophyllum. **K.** H. Halleri. **L.** H. aduncum. **M.** H. Sendtneri. **N.** H. Wilsoni.

TAB. LVIII.

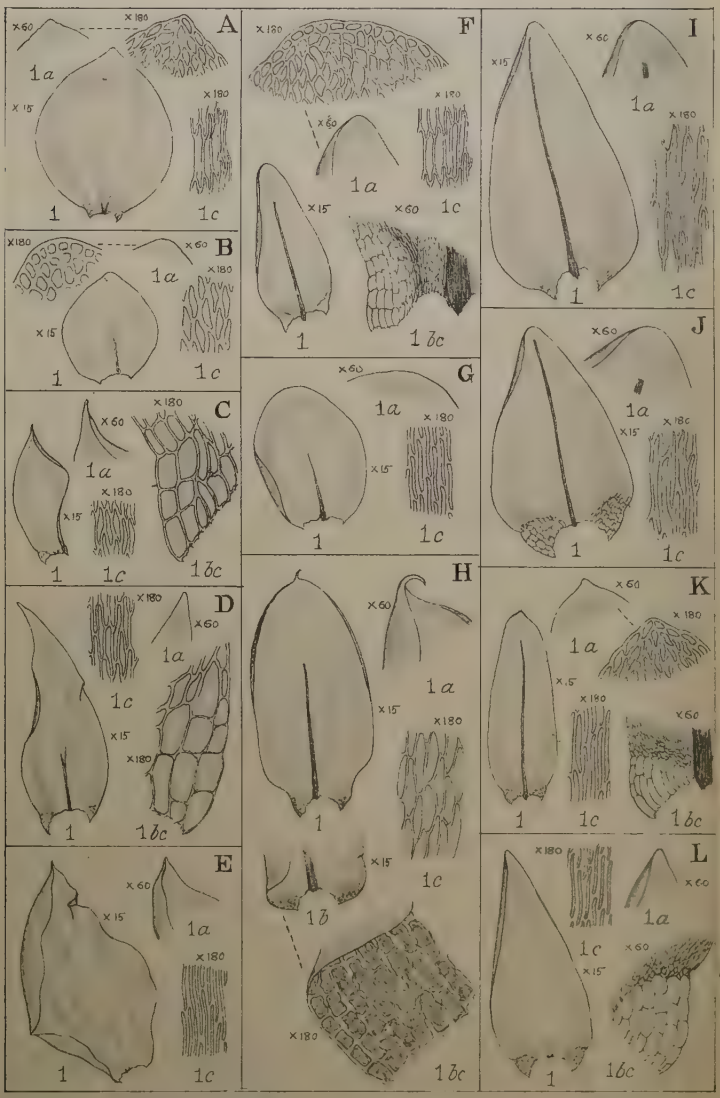


A. Hypnum lycopodioides. **B.** H. fluitans. **C.** H. exannulatum **D.** H. uncinatum. **E.** H. vernicosum. **F.** H. revolvens. **G.** H. intermedium **H.** H. decipiens **I.** H. commutatum. **J.** H. falcatum. **K.** H. sulcatum.

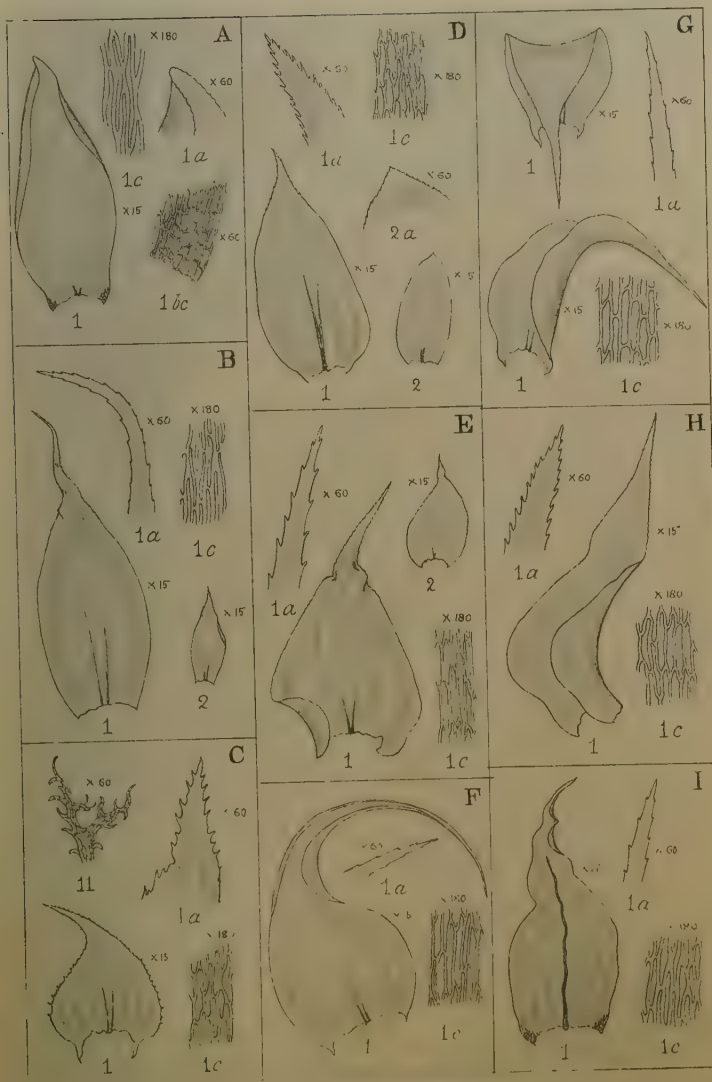


A. Hypnum incurvatum. **B.** H. cupressiforme. **C.** H. imponens.
D. H. Patientiae. **E.** H. revolutum. **F.** H. hamulosum. **G.** H. callichroum.
H. H. Bambergeri. **I.** H. canariense. **J.** H. procerrimum. **K.** H. molluscum.
L. H. crista-castrensis. **M.** H. palustre. **N.** H. molle.

TAB. LX.



A. Hypnum dilatatum. **B.** H. arcticum. **C.** H. eugyrium. **D.** H. ochraceum.
E. H. scorpioides. **F.** H. stramineum. **G.** H. trifarium. **H.** H. turgescens.
I. H. cordifolium. **J.** H. giganteum. **K.** H. sarmentosum. **L.** H. cuspidatum.



A. Hypnum Schreberi. **B.** Hylocomium splendens. **C.** H. umbratum.
D. H. pyrenaicum. **E.** H. brevirostre. **F.** H. loreum. **G.** H. squarrosum
H. H. triquetrum. **I.** H. rugosum.

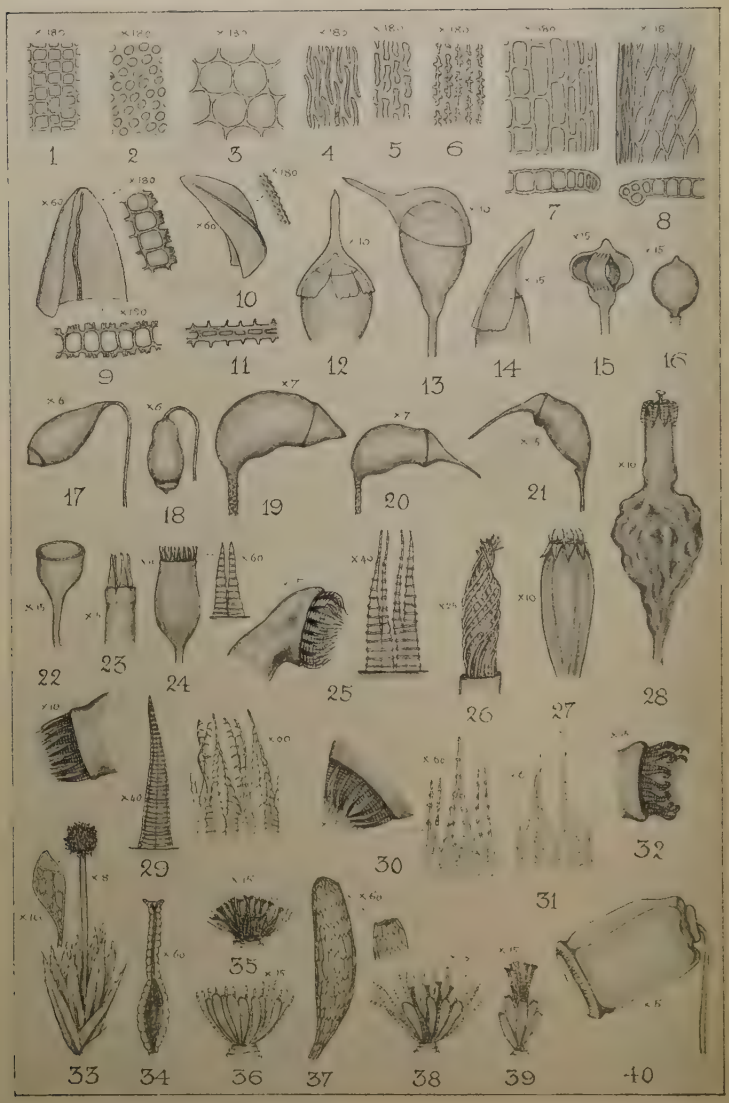
TAB. LXII.

A. Fissidens algarvicus. **B.** Trichostomum limosellum. **C.** Bryum rufifolium.

REFERENCES TO TAB. LXII.

1. Acrocarpous stem, with erecto-patent leaves, *Tortula angustata.*
2. Do., with radicular tomentum, *Mnium punctatum.*
3. Pleurocarpous stem, with falcato-secund leaves, *Hypnum uncinatum.*
4. Pleurocarpous stem, *Camptothecium sericeum.*
5. Part of stem, with paraphyllia, *Thuidium tamariscinum.*
6. Stem showing stem leaves (*a*), branch leaves (*b*), perichaetial leaves (*c*), paraphyllia (*d*), and rough seta (*e*), *Eurhynchium praelongum.*
7. Imbricate leaves, *Myurella julacea.*
8. Squarrose-recurved leaves, *Barbula fallax.*
9. Distichous, nerveless leaves, *Schistostega osmundacea.*
10. Distichous, equitant leaves, with percurrent nerve, *Fissidens bryoides.*
11. Complanate, undulate leaves, *Neckera pumila.*
12. Secund (homomallous) leaves, *Dicranum scoparium.*
13. Cuspidate apex of leaf, *Phascum cuspidatum.*
14. Mucronate apex, *Cinclidotus Brebissoni.*
15. Convolute, sheathing perichaetial leaves, *Barbula convoluta.*
16. Decurrent leaf, *Bryum Duvalii.*
17. Hyaline point to leaf, *Grimmia apocarpa.*
18. Piliferous (hair-pointed), lamellate leaf, *Tortula lamellata.*
19. Doubly toothed, undulate leaf, with lamellate nerve, *Catharinea undulata.*
20. Falcate, acuminate, auricled leaf, *Hypnum cupressiforme.*
21. Subulate, auricled leaf, with wide nerve, *Campylopus Shawii.*

TAB. LXIII.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REFERENCES TO TAB. LXIII.

1. Quadrate leaf-cells, *Barbula rubella*.
2. Rounded and incrassate cells (punctate), *Orthotrichum leiocarpum*.
3. Rounded and collenchymatous cells, *Mnium serratum*.
4. Vermicular cells, *Hypnum Sendtneri*.
5. Sinuose cells (basal), *Andreaea alpina*.
6. Nodulose cells (basal), *Rhacomitrium protensum*.
7. Parenchymatous cells, with border of narrow cells (with section), *Tortula subulata*.
8. Prosenchymatous, rhomboid cells, with thickened, bistratose border (with section), *Bryum Donianum*.
9. Papillose (verruculose) leaf-apex, with border and section enlarged, *Encalypta streptocarpa*.
10. Papillose leaf, seen in profile, *Leskea polycarpa*.
11. Section of papillose leaf, *Aulacomnium palustre*.
12. Mitriform, campanulate calyptra, *Physcomitrium pyriforme*.
13. Cucullate calyptra, *Funaria fascicularis*.
14. Do., *Pottia Wilsoni*.
15. Capsule opening by longitudinal slits, *Andreaea petrophila*.
16. Cleistocarpous capsule, *Ephemerum serratum*.
17. Pyriform, cernuous capsule, *Bryum alpinum*.
18. Pendulous capsule, with mamillate lid, *Bryum atropurpureum*.
19. Capsule with conical lid and rough seta, *Brachythecium rutabulum*.
20. Do. with rostrate lid, *Eurhynchium praelongum*.
21. Capsule with strumose neck, *Dicranella cerviculata*.
22. Gymnostomous capsule, *Pottia truncatula*.
23. Peristome with 4 teeth, *Tetraphis pellucida*.
24. Do. with 16 simple teeth, and two teeth enlarged, *Dicranoweisia crispula*.
25. Do. with 16 trabeculate, cloven teeth (dicranoid), and two teeth enlarged, *Dicranella heteromalla*.
26. Twisted peristome, *Barbula fallax*.
27. Striated capsule, with double peristome, the outer teeth paired and recurved, *Ulota Bruchii*.
28. Capsule with rugose apophysis and exserted columella, *Splachnum ampullaceum*.
29. Double peristome, the inner with processes and appendiculate cilia, *Bryum capillare*.
30. Do., the inner with nodulose cilia, *Mnium punctatum*.
31. Inner peristome with rudimentary cilia, *Webera elongata*.
32. Double peristome, *Eurhynchium murale*.
33. Pseudopodium with head of gemmae, and enlarged clavate gemma, *Aulacomnium androgynum*.
34. Archegonium, *Bryum pallens*.
35. Female flower, *B. pallens*.
36. Male flower, with paraphyses, *B. pallens*.
37. Antheridium, and apex when ruptured, *B. pallens*.
38. Synoicous flower, *Bryum bimum*.
39. Paroicous inflorescence, *Webera polymorpha*.
40. Apophysate, cubic capsule, with epiphragm and 64 peristome teeth, *Polytrichum commune*.

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